

POLYGRAPHY DEP

INDIA RUBBER WORLD

OUR

64th YEAR

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JANUARY, 1953

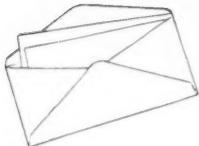


Extra Mileage Up to 40% Better Wear than Standard HAF

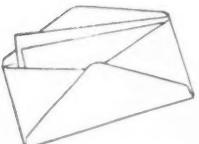
GODFREY L. CABOT, INC., BOSTON

* Super Abrasion

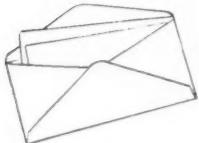
Our customers tell us:



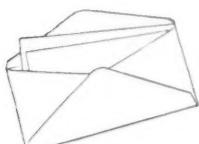
● "We've tried Du Pont RR-10 and the results are excellent. It looks especially good in Banbury reclaiming."



● "We've found RR-10 an effective remedy for bringing back scorched neoprene stocks."



● "0.5 to 1.0 part of RR-10 is an effective means of reducing scorching in neoprene stocks."



● "RR-10 is outstanding in both straight and mixed GR-S scrap and does an excellent job in the pan process."

DU PONT RR-10 has been found by many companies to be the most effective agent ever tried for reclaiming rubber, GR-S, and mixtures of these elastomers. It is also being used successfully on neoprene, buna N, and mixtures of GR-S and high styrene resins.

Manufacturers have speeded up their reclaim operations, saved money, and increased quality by using Du Pont RR-10. Its action is so powerful that less reclaiming oil is required . . . and the reclaims are smooth and have good tack.

A factory trial is the best method of getting acquainted with Du Pont RR-10. For a sample and complete information, write or call our nearest district office.

DISTRICT OFFICES:

Akron 8, Ohio, 40 E. Buchtel Ave..... HEmlock 3161
Atlanta, Ga., 1261 Spring St., N.W..... EMerson 5391
Boston 5, Mass., 140 Federal St..... HAncok 6-1711
Chicago 3, Ill., 7 South Dearborn St.. ANDover 3-7000
Los Angeles 1, Cal., 845 E. 60th St.... ADams 3-5206
New York 13, N. Y., 40 Worth St.... COrtlandt 7-3966
Wilmington 98, Del., 1007 Market St... Wilm. 4-5121

DU PONT RUBBER CHEMICALS

E. I. du Pont de Nemours & Co. (Inc.), Wilmington 98, Del.



BETTER THINGS FOR BETTER LIVING... THROUGH CHEMISTRY

News about

B. F. Goodrich Chemical *raw materials*

**Improve and save on
your rubber processing
with
Good-rite Vultrol**

REG. U. S. PAT. OFF.

Vultrol

- ... PROTECTS AGAINST SCORCHING
- ... PERMITS UNINTERRUPTED PRODUCTION
- ... REDUCES "DEAD" STOCKS
- ... REQUIRES NO SPECIAL HANDLING

Good-rite Vultrol offers you many advantages for rubber processing. It is ideal for preventing scorching not only during the hot weather months—but the year round. It retards scorch at processing temperatures, and also acts as a mild activator at curing temperatures.

Check these additional Vultrol advantages. It is beneficial on heavy-loaded or highly-accelerated compounds, and is particularly effective with high abrasion furnace blacks.

Supplied as a free-flowing flake, Vultrol requires no special handling—is non-toxic. It is most effective when added to the latter stages of mixing. Economical and easy to use. Saves time, money and labor! For further information about Good-rite Vultrol, please write Dept. HA-1, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

B. F. Goodrich Chemical Company
A Division of The B. F. Goodrich Company

Good-rite Rubber Chemicals

GEON polyvinyl materials • HYCAR American rubber • GOOD-RITE chemicals and plasticizers • HARMON organic colors



Each Philblack has a job to do! They will improve your product, too!*

What are your needs! Abrasion resistance? Easy processing? Flex life? Accurate moldings? Electrical conductivity? There's a Philblack to fulfill every requirement.

Use *Philblack E* when you want super abrasion resistance. This SAF black adds as much as 42% longer life to cold rubber tire treads. Super resistance to cut and crack growth, too!

Use *Philblack O* for excellent abrasion resistance, long

flex life and good electrical conductivity. This HAF black is used extensively in tires, industrial belts and hoses.

Use *Philblack A* to ease processing troubles, assure accurate moldings and smooth, fast tubing—a black to improve appearances of finished products.

For full information, consult our technical sales representative who calls on you or write our nearest office.

PHILLIPS CHEMICAL COMPANY



PHILBLACK SALES DIVISION

EVANS BUILDING • AKRON 8, OHIO

PHILBLACK EXPORT SALES DIVISION • 80 BROADWAY • NEW YORK 5, N.Y.

Philblack E, Philblack O and Philblack A are manufactured in Borger, Texas. Warehouses in Akron, Boston, Chicago and Trenton. West Coast agent: Harwick Standard Chemical Company, Los Angeles. Canadian agent: H. L. Blachford, Ltd., Montreal and Toronto.



*
A Trademark

Have you "discovered"....



Paracril?

You're missing a bet if you're not one of the thousands who have "discovered" and are profiting from this amazing oil-resistant rubber!

You'll find, as manufacturers everywhere have, that this unusual butadiene-acrylonitrile copolymer offers a far superior combination of properties—for superior rubber products.

Naugatuck Chemical's Paracril provides—

- outstanding oil resistance

- excellent processing characteristics
- remarkable resistance to normal and high-temperature aging
- extreme low-temperature flexibility
- high abrasion resistance and good set

Uses? Practically wherever rubber has been used—and in many applications unsuited to natural or other synthetic rubbers. Available in crumb or bale form, Paracril may be used for extrusions, calendering, molding, or cements—may be blended with vinyl resins, phenolics, or other rubbers to add unique new performance features.

Why not discover Paracril's many advantages for yourself? For free samples of specific types of Paracril, or free data thereon, write to address below.



Naugatuck Chemical

Division of United States Rubber Company

131 ELM ST., NAUGATUCK, CONNECTICUT

IN CANADA: NAUGATUCK CHEMICALS DIVISION • Dominion Rubber Company, Limited, Elmira, Ontario
Rubber Chemicals • Aromatics • Synthetic Rubber • Plastics • Agricultural Chemicals • Reclaimed Rubber • Latices

PROTOX Zinc Oxides Stack

HIGHER and DENSER

EXPAND YOUR STORAGE SPACE WITH PROTOX...

Cut costs 3 ways!



Protox-166 more than doubled the zinc-oxide storage capacity of this warehouse. Three 60-bag unit loads (4.5 tons) occupy the same floor space as two 42-bag units (2.1 tons) of a conventional zinc oxide packaged in the usual way.

You can load up to 50% more Protox on each skid or pallet — because bags of Protox are denser than conventional zinc oxides.

You can stack pallet-loads of Protox higher — because bags of Protox are flatter, make a more stable load.

These Protox advantages expand your storage space and save you dollars in these important ways:

1. Save on storage costs

You can store more Protox per square foot of floor space.

2. Save in purchasing

Take advantage of c.l. vs. l.c.l. prices. Buy Protox in carloads instead of conventional zinc oxides in l.c.l. quantities.

3. Save on production costs

You can carry larger stocks of materials to protect your production schedules.

Protox zinc oxides cut production costs in other ways, too. You can process Protox zinc oxides faster. Their unique coating of zinc propionate provides quicker mixing, more complete dispersion, reduces need for masterbatching.

THE NEW JERSEY ZINC COMPANY

Producers of Horse Head Zinc Pigments

... most used by rubber manufacturers since 1852

160 Front Street, New York 38, N. Y.



Sole makers —

Here's why you should use



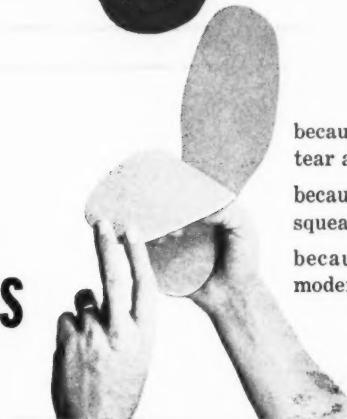
-in light soles



-in black soles



-in inner soles



because normal processing temperatures don't darken this resin like they do most competitive rubber reinforcing resins

because pigments disperse thoroughly with a minimum of streaking and splotching

because you get adequate hardness without excessive loading and difficult mixing

You can prove these statements yourself. Write for a demonstration of heat stability of PLIOLITE S-6B

because of excellent abrasion resistance even at high loading with Fine Thermal Blacks

because good firmness is achieved with all types of Carbon Blacks

because quality is improved while costs are kept low

Try PLIOLITE S-6B in shoe soles to meet military specifications such as MIL-S-10047 and MIL-S-1762

because you can raise your standards for hardness, tear and permanent set

because PLIOLITE S-6B eliminates crack, curl and squeak of many competitive types of inner sole

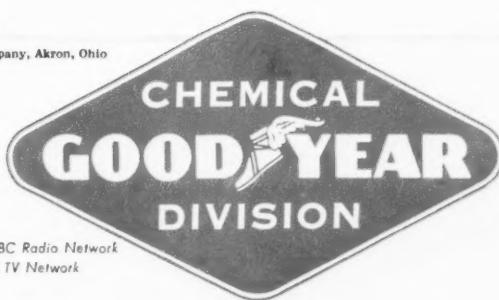
because you can gain uniform high quality at moderate cost

Chemigum, Pliobond, Pilolite, Plivic—T.M.'s The Goodyear Tire & Rubber Company, Akron, Ohio

Wherever rubber needs reinforcement, it will pay you to try PLIOLITE S-6B. Write for details to:

Goodyear, Chemical Division, Akron 16, Ohio

We think you'll like "THE GREATEST STORY EVER TOLD"—every Sunday—ABC Radio Network
THE GOODYEAR TELEVISION PLAYHOUSE—every other Sunday—NBC TV Network



Use-Proved Products—CHEMIGUM • PLIOBOND • PLIOLITE • PLIVIC • WING-CHEMICALS—The Finest Chemicals for Industry

SEE
WHAT *They* SAY

ABOUT

Giffels & Vallet

GIFFELS & VALLET, INC.

INDUSTRIAL ENGINEERING DIVISION

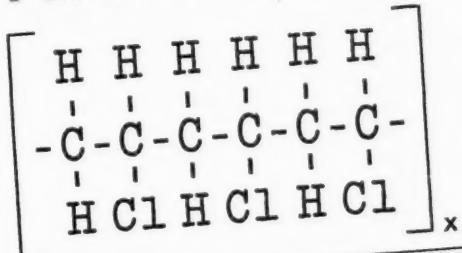
1000 Marquette Bldg. • Detroit 26, Michigan

BANBURY CHARGING

WESTERN ELECTRIC COMPANY — BALTIMORE, MARYLAND

For rapid, low-temperature processing

Use this great NEW polyvinyl chloride resin **PLIOVIC G80V**



PRODUCTION TRIAL #156

Pliovic G80V: Goodyear Resin

The resin, stabilizer and lubricant were placed in the blender, the blades started rotating, hot plasticiser was poured in across the batch, and the lid of the blender lowered. The batch was completely blended for mill mixing in less than a minute and it flowed out through the opening at the top with no difficulty whatsoever. The batch was satisfactorily blended even after this very short cycle.

Two mills were used for banding the compound, and one mill was used to finish the fluxing and stripping off. It was all the two breakdown mills could do to keep up with the stripping mill, and the granulator could not keep up with production due to the fact that the resin fluxed and milled so rapidly. This is the fastest processing resin we have ever seen.

• Now available in commercial quantities, PLIOVIC G80V is the second in a series of new Goodyear polyvinyl chloride resins. Introduced primarily for use where low temperatures (20-40° F. lower than PLIOVIC G90V) and rapid processing are required, its success has been proved by customer use across the country — with results like those shown in the production report.

You can secure samples and full details for evaluation in your own plant on both PLIOVIC G90V and the new G80V by writing:

Goodyear, Chemical Division, Dept. 1-B, Akron 16, Ohio

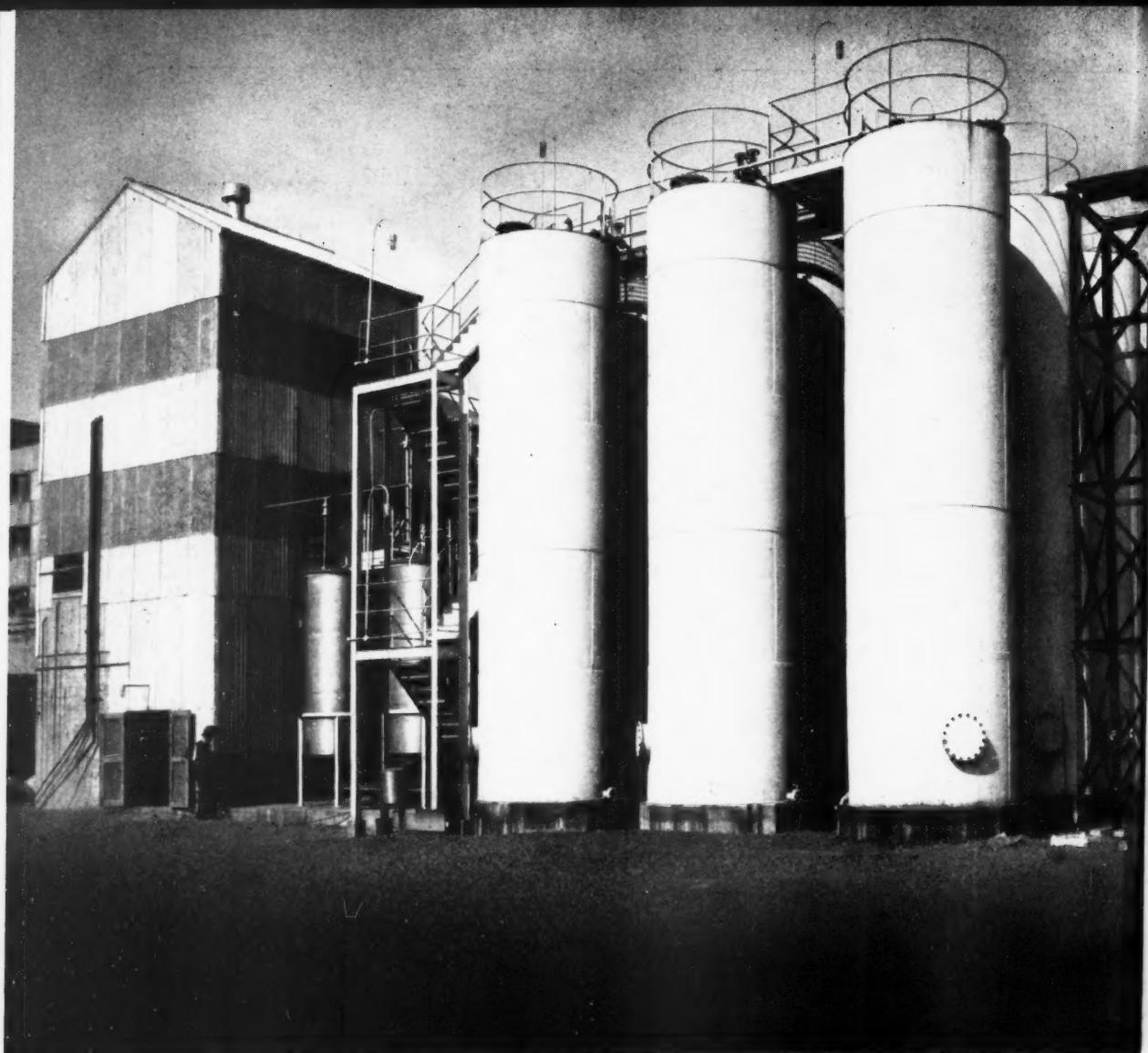


We think you'll like "THE GREATEST STORY EVER TOLD" —
every Sunday—ABC Radio Network

THE GOODYEAR TELEVISION PLAYHOUSE—
every other Sunday—NBC TV Network

Chemigum, Pliobond, Pliolite, Pliovic—T.M.'s
The Goodyear Tire & Rubber Company, Akron, Ohio

Use-Proved Products — CHEMIGUM • PLIOBOND • PLIOLITE • PLIOVIC • WING-CHEMICALS — The Finest Chemicals for Industry



THE COMPANY'S new plasticizer plant includes a modern processing unit and this large tank farm for raw materials and finished plasticizers.

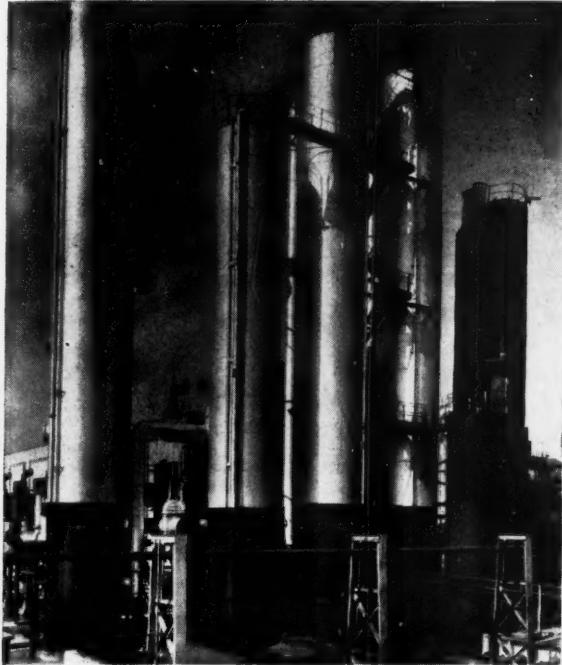


1 SOURCE of basic coal chemicals for PX Plasticizers is this battery of 140 coke ovens. Fed from large coal stock piles in foreground, they operate around the clock.

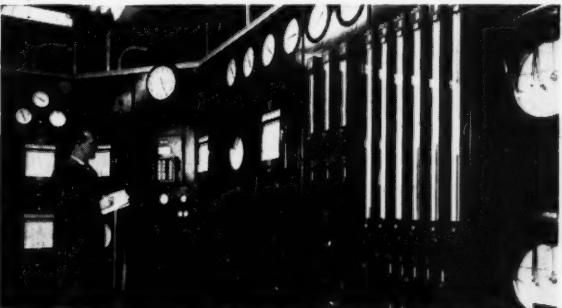
NEW BASIC PLASTICIZER Controls quality from coal

ONE million pounds per month have been added to the nation's plasticizer production capacity with the completion of Pittsburgh Coke & Chemical Company's new plasticizer plant this month. Erected at Neville Island, near Pittsburgh, Pa., the new plant is located in the heart of one of our most plentiful sources of coal and other important raw materials.

Pittsburgh's new plant is completely integrated with the company's basic coal chemical production facilities at Neville Island. Molten phthalic anhydride, for example, is piped directly to the plasticizer plant from Pittsburgh's adjoining phthalic plant. As a result of this unique basic and integrated position, the new



2 **BASIC** coal chemicals used in making PX Plasticizers are recovered from coke ovens in modern chemical equipment like this at Pittsburgh's integrated plant.



3 **HIGH QUALITY** of phthalic anhydride, important plasticizer intermediate, is rigidly maintained. Pittsburgh's molten phthalic is piped directly to plasticizer plant.

PLANT IN PRODUCTION to finished product

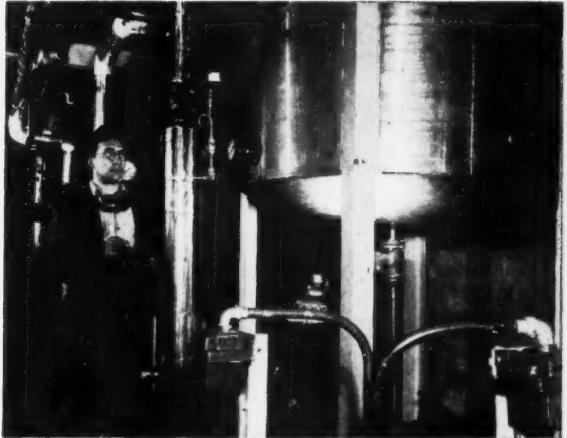
added to
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company's
at Neville
is located
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ion facil-
rde, for
plant from
result of
the new

plant can produce clear, water-white plasticizers that are quality controlled from coal to finished product.

Customers of Pittsburgh Coke & Chemical are assured of two other important benefits because of the company's ability to control every phase of plasticizer production: (1) Plasticizers of consistent peak quality, regardless of whether shipments are made by the pound or by the tank carload. (2) Prompt deliveries and continuing supplies, regardless of varying market conditions affecting material supplies.

COAL CHEMICALS • AGRICULTURAL CHEMICALS • FINE CHEMICALS • PROTECTIVE COATINGS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON

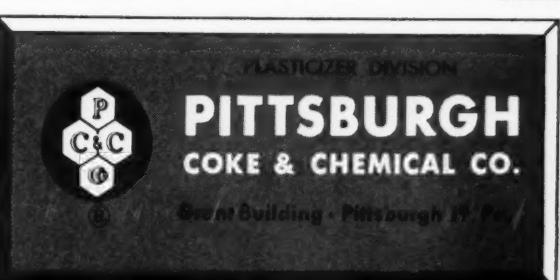


4 **PROCESSING TANKS** like a large part of the new plant's equipment, are made of stainless steel to help protect the quality and purity of finished plasticizers.



5 **DRUMMING OFF** Pittsburgh PX Plasticizers is accomplished on special filling scales. When correct weight is attained, flow of plasticizer is automatically stopped.

WBD4424



Make sure of Permanent Whites
with **PEQUANOC'S**

**BIG
3**

**LOW-STAINING
RECLAIMS**

These low staining black reclaims may be used in contact with white on tire side-walls or lacquered surfaces—where migration may contribute to discoloration.

PEQUANOC #1500

Standard quality — High Mooney — Low Stain

PEQUANOC #1551

Standard quality — Low Mooney — Low Stain

PEQUANOC #1575

Premium Grade — Low Mooney — Maximum Stain Resistance.

We will be glad to submit samples or further technical information.

Pequanoc Rubber Co.

MANUFACTURERS OF RECLAMED RUBBER

MAIN SALES OFFICE and FACTORY: BUTLER, N. J.



FORTEX®

A new discovery in rubber compounding and processing!

Thermoid Chemical Co. announces a thoroughly tested new rubber chemical which is unique in that it acts as a low-temperature breakdown plasticizer. Far from diluting the stock on further compounding, it actually FORTifies and EXTends it—hence, its name. Its use yields a better stock at less cost.

AS A PROCESSING AID:

1. A breakdown plasticizer and peptizer in Banbury and internal mixing. Add directly to elastomer so it may also act as
2. a pigment wetting and dispersing agent and
3. anti-cross-link agent in GR-S.
4. Anti-scorch in mixing and processing.
5. Aids tubing and calendering.
6. Smooths Buna N.
7. Aids mold flow. Does not cause sticking.

AS A COMPOUNDING AID:

1. Reinforcer; hardness, modulus and tensile strength increase at same rate of cure.
2. Extender of elastomer by direct mix or co-coagulation.
3. Age resistant.
4. Replaces stearic acid and retarders in whole or in part.
5. Imparts better tear resistance.
6. Improves resilience.

Distributed by
Herron Bros. & Meyer, Inc.
Akron, O., New York, N. Y.,
Chicago, Ill.



THERMOID CHEMICAL CO.
A Subsidiary of the Thermoid Co.
Trenton, N. J.

THERMOID CHEMICAL CO.
220 Whitehead Road
Trenton, N.J.

Please send me full details on FORTEX as an aid in rubber compounding and processing.

NAME _____ TITLE _____

COMPANY _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

Q. How does FORTEX fortify and extend?

A. A 5 to 10% extension of the elastomer gives physicals equivalent and sometimes superior to the original rubber.

Q. What is the composition of FORTEX?

A. It's a partially aromatized hydrophenanthrenic material of vegetable origin, chemically treated to block unsaturation.

Q. What are its properties?

A. FORTEX is a viscous, brown liquid, with characteristic odor disappearing completely on mixing and curing. It is non-toxic. Requires warming for easy pouring. Specific gravity: 1.04.

Q. Is it compatible with all elastomers?

A. FORTEX is highly compatible with all elastomers except polysulfide rubbers.

Q. How is it added to the elastomer?

A. Directly for elastomer breakdown, or otherwise as a regular plasticizer.

Q. How does FORTEX compare with conventional peptizers?

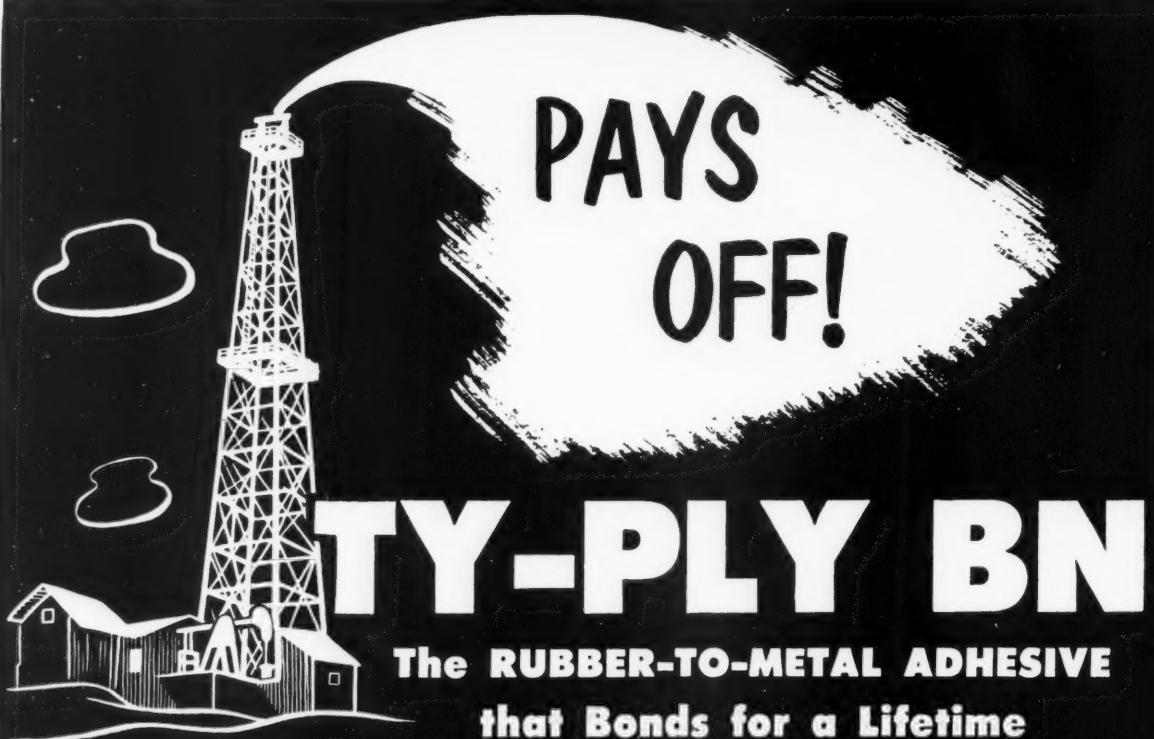
A. As a breakdown plasticizer, FORTEX prevents cross-linkage and maintains molecular weight in the softened elastomer.

Q. How does it work in internal mixers?

A. Free flowing FORTEX incorporates rapidly to produce relatively smooth plasticized rubber with no increase in mixing time.

Q. Will FORTEX replace stearic acid?

A. It can replace all or part of the stearic acid in the recipe.



PAYS
OFF!

TY-PLY BN

The RUBBER-TO-METAL ADHESIVE
that Bonds for a Lifetime

For vulcanized adhesion of Buna N's to steel, TY-PLY BN bonds are stronger than the compound — unaffected at 500 Degrees Fahrenheit or in the presence of acids, solvents, plasticizers, aromatic and halogenated hydrocarbons, and hot oils.

TY-PLY **Q** or **3640** for bonding Natural, GR-S, and Butyl

TY-PLY **S** for bonding Neoprene

TY-PLY will adhere most vulcanizable rubber compounds to almost any clean metal surface!

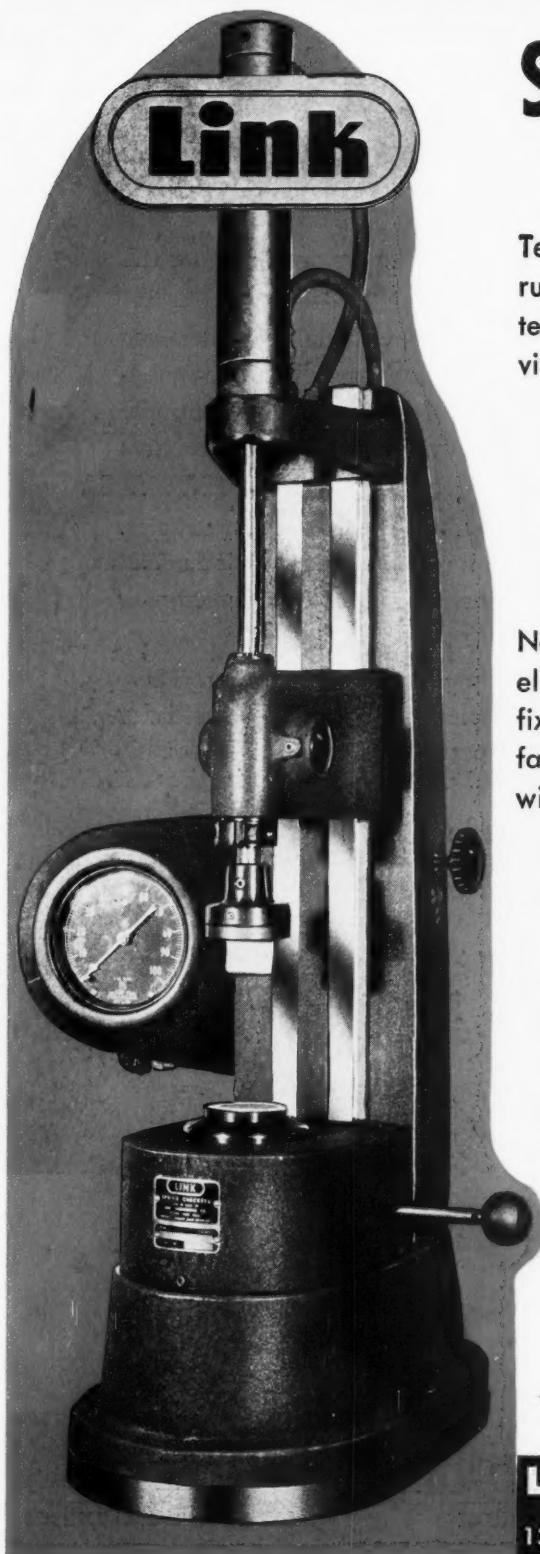


MARBON CORP.
GARY, INDIANA
SUBSIDIARY OF BORG - WARNER

TY-PLY has stood the test of time . . . since '39

PRODUCTION SPEED

with Laboratory Accuracy



SPRING TESTER

Works on New Principle

Tests any resilient material — including cork, felt, rubber, sponge rubber, springs (for compression, tension, torsion) piston rings, motor mounts, Belleville washers.

Your Choice of Gauges —
"GO" or "NO-GO", or
Reading Directly in Pounds

New principle cuts hand and eye motion 60%, by eliminating height measurement. Height remains fixed, regardless of load. This reduces operator fatigue and cuts cycles to about TWO SECONDS, with air cylinder type tester, as illustrated.

Hand Operated Types
Also Available

WRITE FOR ILLUSTRATED LITERATURE

Other Link Products

- ★ Electric Dynamometers, A.C. and D.C.
- ★ Continuous Indicating Lubricating Oil Consumption Scale
- ★ Platform Scales
- ★ Torsion Testing Machines
- ★ Fatigue Testing Machines
- ★ Hydraulic Presses
- ★ Tension Registering and Automatic Control Device

Representatives wanted — write for open territory

LINK ENGINEERING CO.
13843 ELMIRA AVE., DEPT. R 6 • DETROIT 27, MICH.

WHAT SILICA CHEMISTRY

Du Pont "Ludox" colloidal silica improves

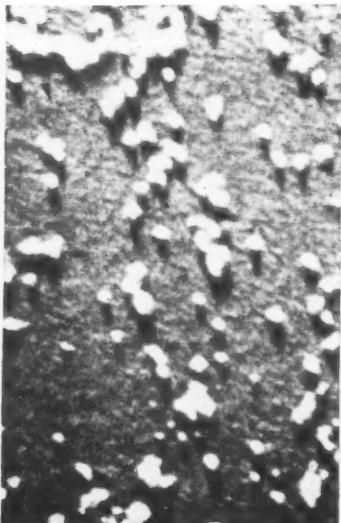
No matter what type of latex products you make, there are opportunities for the silica chemistry of Du Pont "Ludox" to help you expand your markets.

In latex-dipped goods, coatings and adhesives, "Ludox" colloidal silica increases stiffness, toughness and water resistance . . . decreases tackiness, improves adhesion. And this unique combination of properties is not found in any conventional latex additive. You will want to investigate all the advantages "Ludox" can give you by filling in and returning the coupon today.

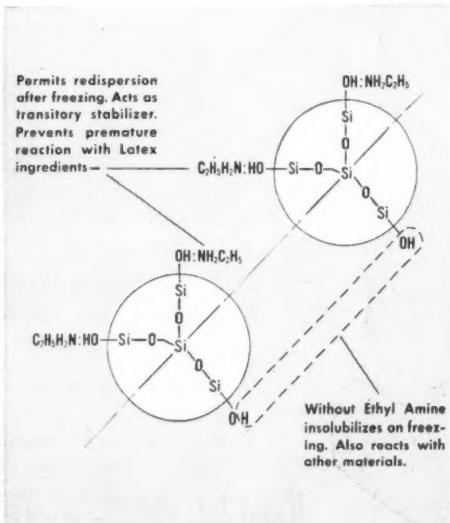
"Ludox" is a 30% colloidal solution of almost pure amorphous silica particles. The electron photomicrograph shows fineness and uniformity of the "Ludox" particles—magnification, 175,000X. The average particle size of 17 millimicrons is below the range of the best carbon blacks.

Surface hydroxyl groups on a "Ludox" micelle are shown in the diagram. These groups make the particles chemically reactive in contrast to commonly used dry fillers. This reactivity has led to many unusual properties and uses for "Ludox" in the latex field.

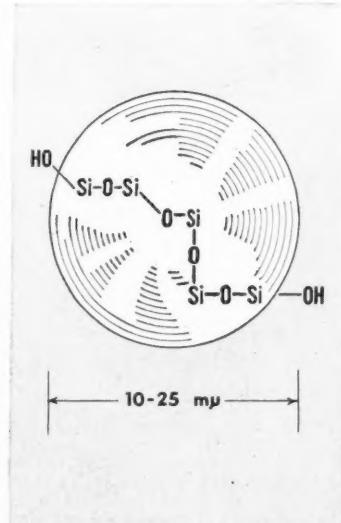
Typical "Ludox" reaction with ethyl amine is also shown below. This is useful in the stabilization of some latices containing "Ludox."



"Ludox" particles at
175,000 magnification.



Reactions with and without monoethylamine.



Structure of "Ludox" particles showing surface hydroxyl groups.

OFFERS LATEX FORMULATORS

latex-dipped goods, coatings, adhesives

INCREASES STIFFNESS. Example: Seven parts of Du Pont "Ludox" colloidal silica solids per 100 parts neoprene latex produced a thread with nearly doubled modulus over the entire range of elongation. Similarly, increased modulus is obtained in natural rubber films.

INCREASES TOUGHNESS. Example: "Ludox" improved adhesion, stopped flaking from neoprene-coated belting. In a paper saturant, abrasion resistance was increased 20 to 40%.

IMPROVES ADHESION. Example: Doubled leather-to-leather adhesion by adding 20 parts of "Ludox" solids per hundred parts of natural rubber latex solids. This effect has also led to use in GRS and neoprene latex adhesives and coatings.

DECREASES TACKINESS. Example: Eliminated surface tack from uncured Buna N solvent coating on cloth. "Ludox" works equally well whether applied as an aftercoat or incorporated in the latex.

INCREASES WATER RESISTANCE. Example: Exceptional increase in water resistance or decrease in water swelling has been obtained with 20 parts "Ludox" solids per 100 parts neoprene latex solids.

DECREASES RUBBER SOLIDS. Example: In neoprene foam, 5 parts of "Ludox" solids per 100 parts of dry neoprene, Type 601, required about 20% less solids to obtain a given modulus than foam without "Ludox." A considerable saving without affecting flex life, bend flex or compression set.

Notice that "Ludox" gives combinations of properties that are difficult to achieve by any other method. And a little "Ludox" goes a long way.

SEND FOR THE "LUDOX" LATEX BULLETIN



E. I. du Pont de Nemours & Co. (Inc.)
Grasselli Chemicals Department, Wilmington, Delaware.

Name _____ Title _____

Company _____

Address _____

City _____ State _____



LUDOX
REG. U. S. PAT. OFF
COLLOIDAL SILICA

BETTER THINGS FOR BETTER LIVING ... THROUGH CHEMISTRY

Freedom of Speech
Freedom of Worship
Freedom from Want
Freedom from Fear

The **FIFTH
FREEDOM**

WHICH HAS HELPED MAKE AMERICA

and Freedom of Choice

...FREEDOM OF CHOICE TO BUY THE VERY BEST:

HARFLEX® PLASTICIZERS

OUTSTANDING FOR
Low Temperature Performance • Weathering Stability
Long Range High Temperature Service

For Plasticizers of QUALITY, write

HARCHEM

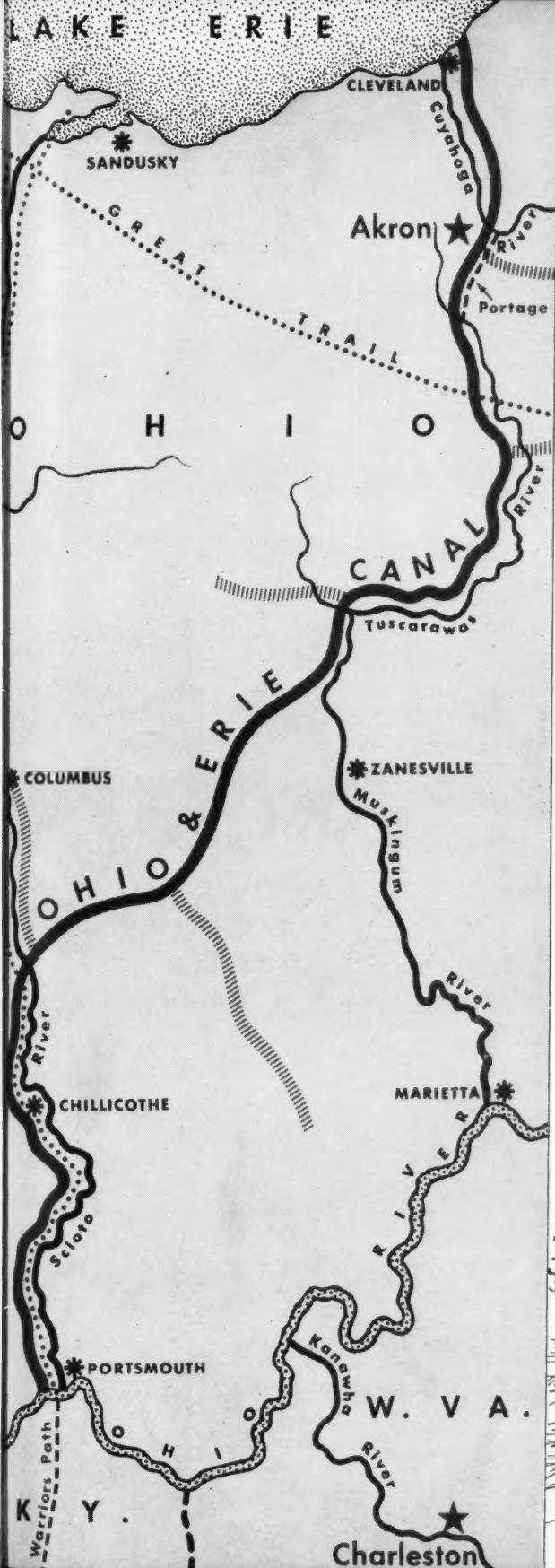
41 EAST 42nd STREET, NEW YORK 17, N.Y.

HARDESTY
CHEMICAL COMPANY, INC.



Manufacturers
of Sebacic Acid

Canadian Distributor: W. C. Hardesty Co. of Canada Ltd., 975 Lakeshore Road, New Toronto, Canada



Getting Into Akron

On July 4, 1827, two years after De Witt Clinton had lifted the first spadeful of earth beginning the project, a boat took off from Akron for Cleveland on the first completed section of the Ohio Erie Canal. Five years later the canal stretched from Lake Erie to Portsmouth, 309 miles away, built at a cost of \$7,904,971. The peak year in the canal's history was 1851, when \$432,711 in fees were collected. Though its importance diminished, the canal continued as a carrier of coal and lumber until 1913.

How far man has progressed in transporting himself and his products! From the principal city along the old canal now flows daily the great contribution to man's swift movement . . . rubber tires. No community in the country is today as distant as once were the shores of Lake Erie from the banks of the beautiful Ohio. On trucks, buses, and automobiles the rubber tire has given man undreamed-of speed in movement.

The rubber tire has been given longer life and better wearing qualities by the addition of carbon black. Carbon black, ever equal to the needs of the rubber industry, is our contribution to the progress in transportation and to Akron, the rubber capital of the world, once an important way point on the Ohio Erie Canal.



UNITED CARBON COMPANY, INC.

We furnish the rubber industry with these well-known carbon blacks of outstanding quality —

UNITED BLACKS

Kosmos 20 - - SRF — Semi-Reinforcing Furnace
Kosmos 40 - - HMF — High Modulus Furnace
Kosmos 50 - - FEF — Fast Extrusion Furnace
Kosmos 60 - - HAF — High Abrasion Furnace
Kosmobile S - - HPC — Hard Processing Channel
Kosmobile HM - MPC — Medium Processing Channel
Kosmobile S-66 MPC — Medium Processing Channel
Kosmobile 77 - EPC — Easy Processing Channel

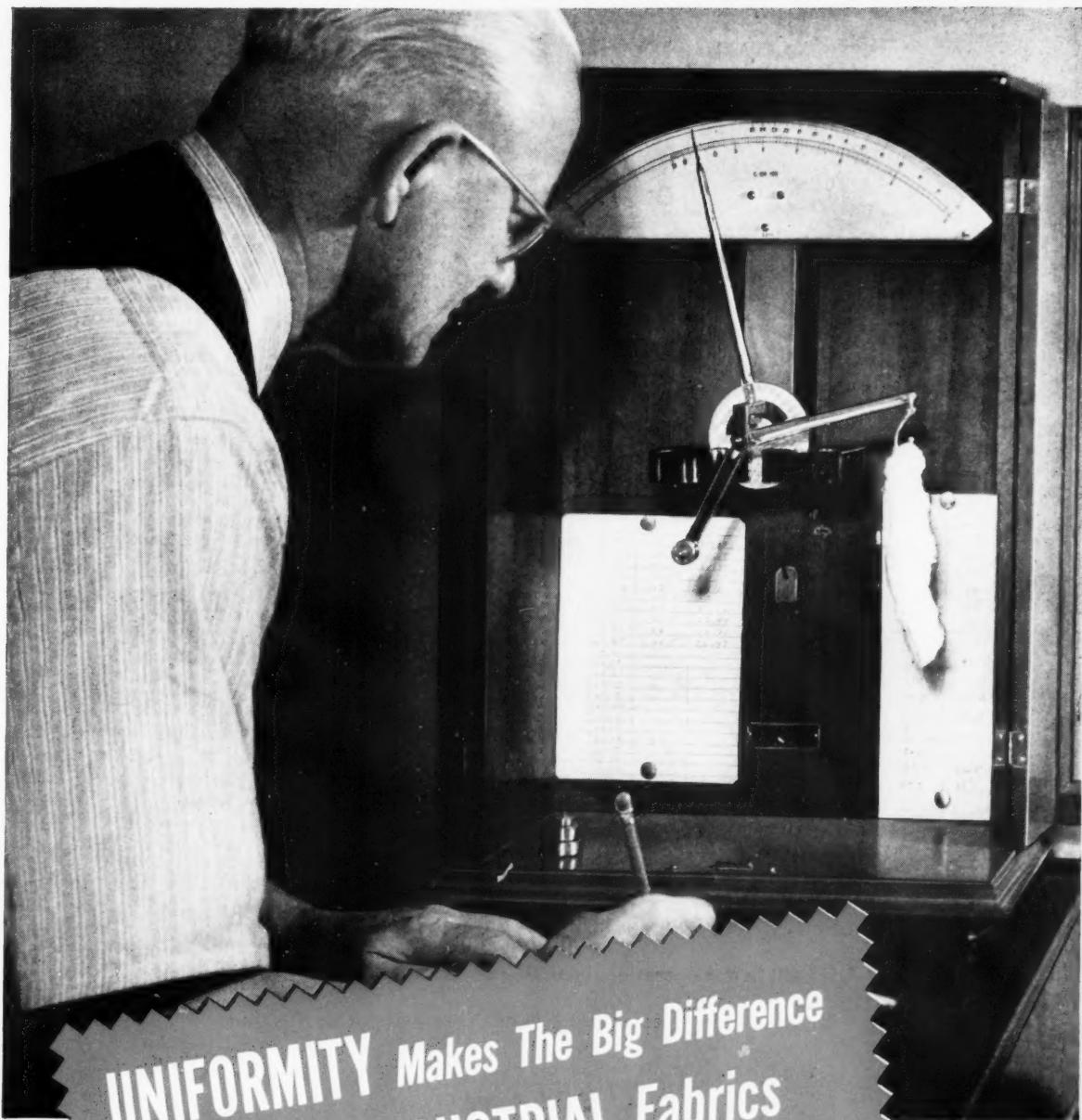
UNITED BLACKS

Discerning rubber compounders obtain their excellent results in a variety of stocks when using our quality blacks.

UNITED CARBON COMPANY, INC.

CHARLESTON 27, W. VA.

NEW YORK AKRON CHICAGO BOSTON
CANADA: CANADIAN INDUSTRIES, LTD.



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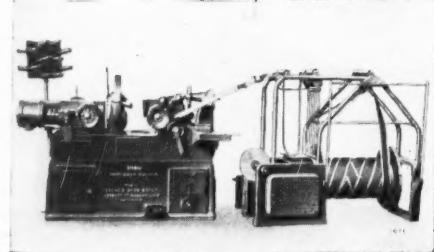
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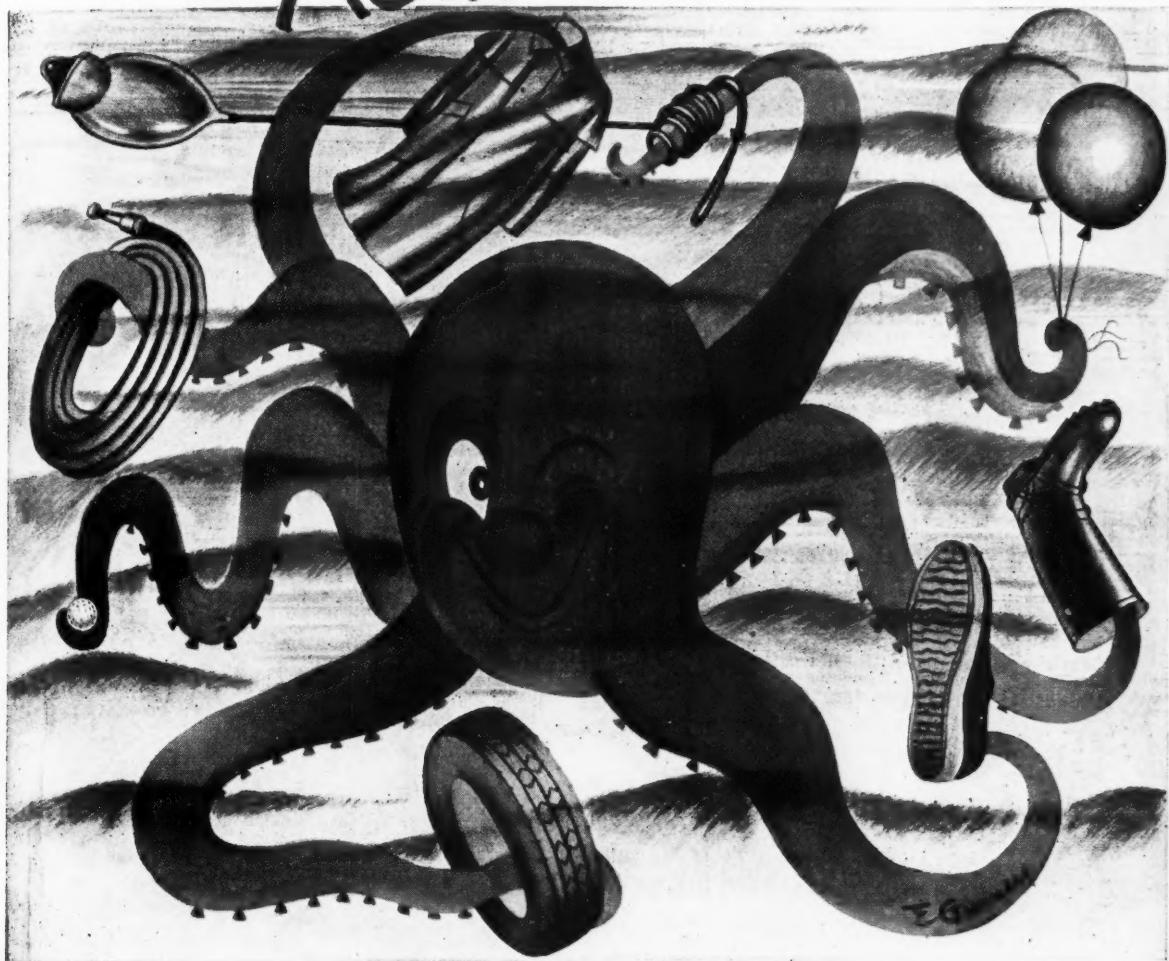
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WORLD

January, 1953

463

When you think of THE Z-TYPE CALENDER you are thinking of FARREL-BIRMINGHAM®

Originated and developed by Farrel-Birmingham engineers, the Z-type calender has established new standards for accuracy in calendering both rubber and plastics. It has proved to be equally outstanding for the high-speed production of film and sheet, and for single and double coating.

The company has also specialized in engineering complete calender trains, incorporating an embosser, cooling train and windup. Other units, such as Banbury mixers and mills, matched in capacity with the calender train, can also be supplied to make production a single integrated operation.

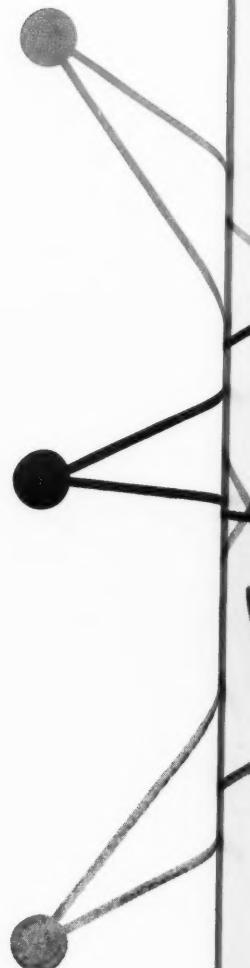
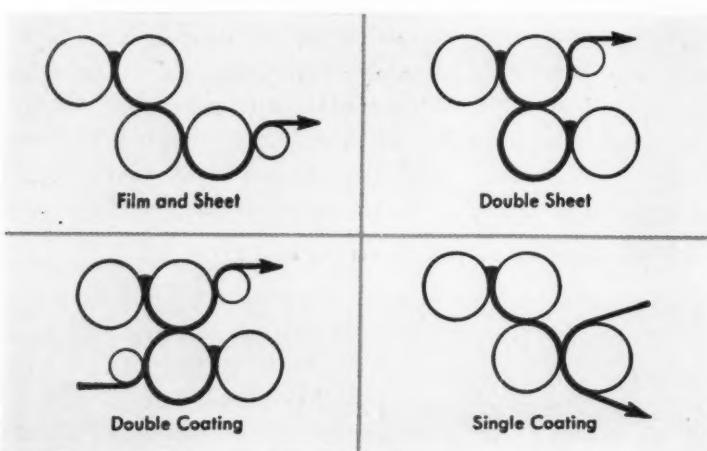
Farrel-Birmingham engineers will be glad to discuss your calendering problems with you.

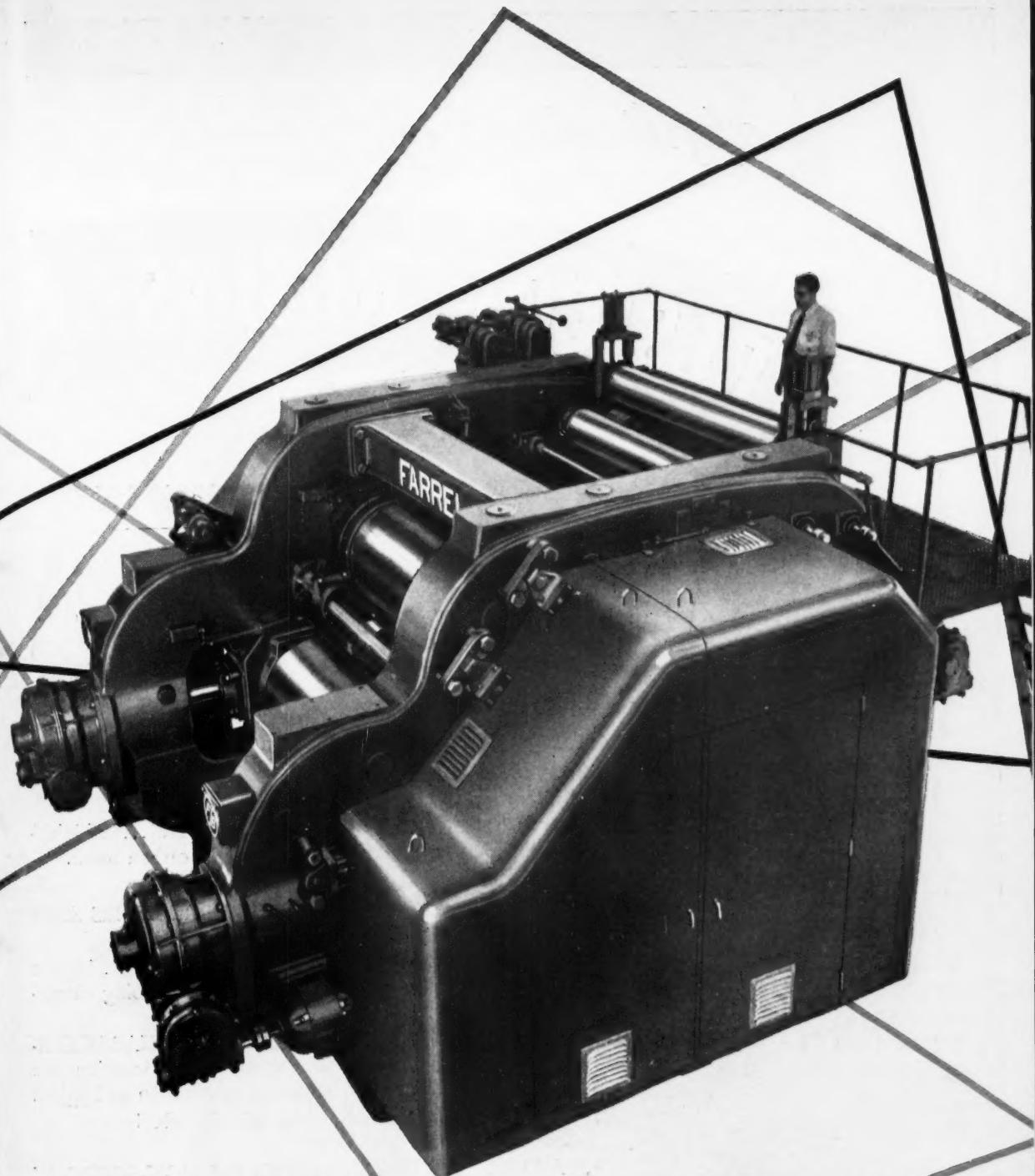
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2. COMPATIBLE WITH NATURAL AND SYNTHETIC RUBBERS.
3. EFFECTIVE PLASTICIZERS AND SOFTENERS...in highly-loaded clay stocks or in recipes incorporating carbon black.
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8. POSSESS HIGH ELECTRICAL RESISTANCE PROPERTIES.
9. AID IN THE DEVELOPMENT OF NON-SCORCHY STOCKS...without excessive retardation of cure at high temperatures.

For additional information concerning properties and applications of Velsicol Resins, write:

VELSICOL

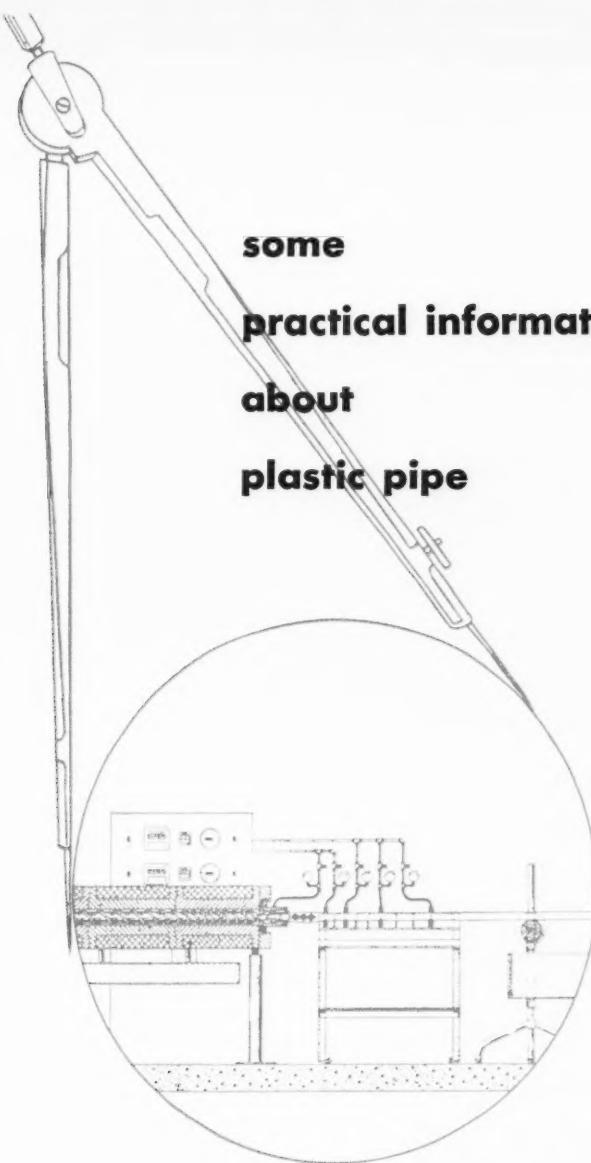
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**some
practical information
about
plastic pipe**

In a plastic process unit you have these basic elements: extrusion; sizing; stress-relieving; cooling; cutting to length; inspection and packaging. In addition, there is also a reclaiming unit for rejected pipe.

Above you see an illustration of the heart of the plastic pipe processing unit . . . extruder with its die, sizing rings and take-off equipment. Herein lies the success or failure of the finished product.

To make plastic pipe, either rigid or flexible, you start with a choice of basic plastics. Today, there are several accepted basics, such as: modified polystyrene; butyrate; polyethylene and either rigid or semi-rigid polyvinyl chloride. Each

of these plastics has specific qualities and individual characteristics. The type you use depends upon the end use to which the finished pipe is to be put.

We have been working with plastics and plastic pipe, and rubber, for many, many years. Our Extruders have produced many miles of plastic pipe. We can give you practical help in setting up either the basic process or the complete plant, designing and building the equipment. Before you undertake your plastic pipe project, consult with the people who know the business.

YOUR INQUIRY — If you want to be in the plastic pipe business, we can help you. A letter of inquiry will receive prompt and confidential attention.



National Erie products for the Plastic and Rubber Industries • Extruders • Simplex Doors for Autoclaves • Mills and Hydraulic Presses.

This old and well-known line of machinery was acquired March 1, 1952, by The Aetna-Standard Engineering Company. They are manufactured in their Warren, Ohio and Ellwood City, Pa., plants. The sales and engineering of the National Erie line is the responsibility of Hale and Kullgren, Inc., Akron, Ohio.

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SKELLYSOLVE-E. For use wherever a relatively slow drying solvent is desired.

SKELLYSOLVE-R. For general use in tire building and a variety of other manufacturing operations and cements. Reduces evaporation losses. Medium quick final dry. Lessens bloating and skinning tendency.

"Doc" MacGEE says: Experience is more than necessary in some fields . . . it is vital. In solvents, you can rely unreservedly on Skellysolve . . . for every shipment is backed by more than 20 progressive years of concentrated solvent experience.

You benefit from that experience in uniformity of solvent characteristics. One batch of Skellysolve is the same as the next because of the strict quality controls that check every step in the manufacturing process. Shipment after shipment gives you the same over-all solvent properties that safeguard your product's uniformly high quality—the best "advertising" any product can possess!

What solvent property is most important in your plant operations? Whether

it's low end points, quick evaporation, reduced blushing tendency, low vapor pressure, minimum of unsaturates and pyrogenic decomposition products or a minimum of low and high boiling compounds—Skellysolve checks!

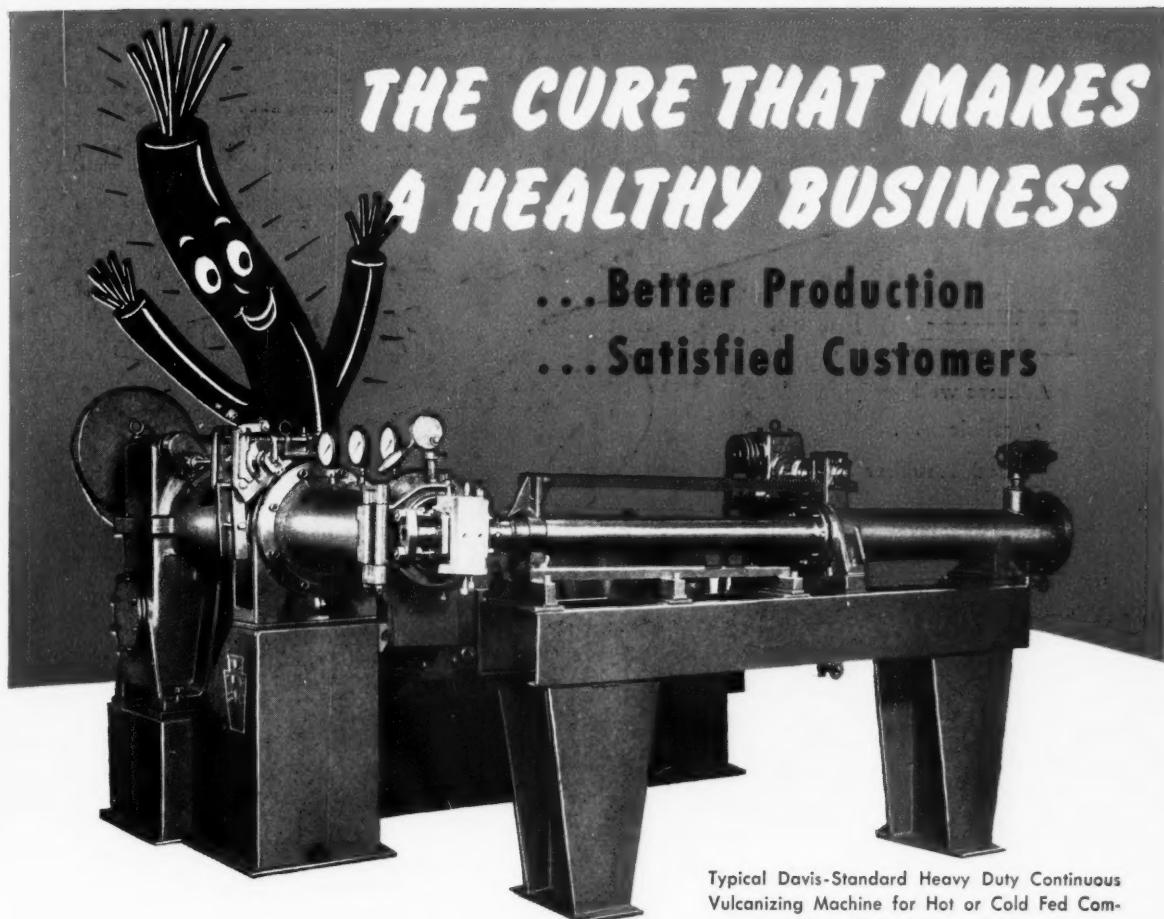
Compare Skellysolve, too, for controlled vapor pressure—assurance against bloated containers. And if rubber cements are your business, Skellysolve's minimum of low boiling compounds banishes worry about "seeds" in your products. High bonding strength is certain with Skellysolve's freedom from greasy residues.

You're invited to write for more complete technical facts. And if you have a special solvent application problem, see if the Skellysolve Technical Fieldman can help you. No obligation.



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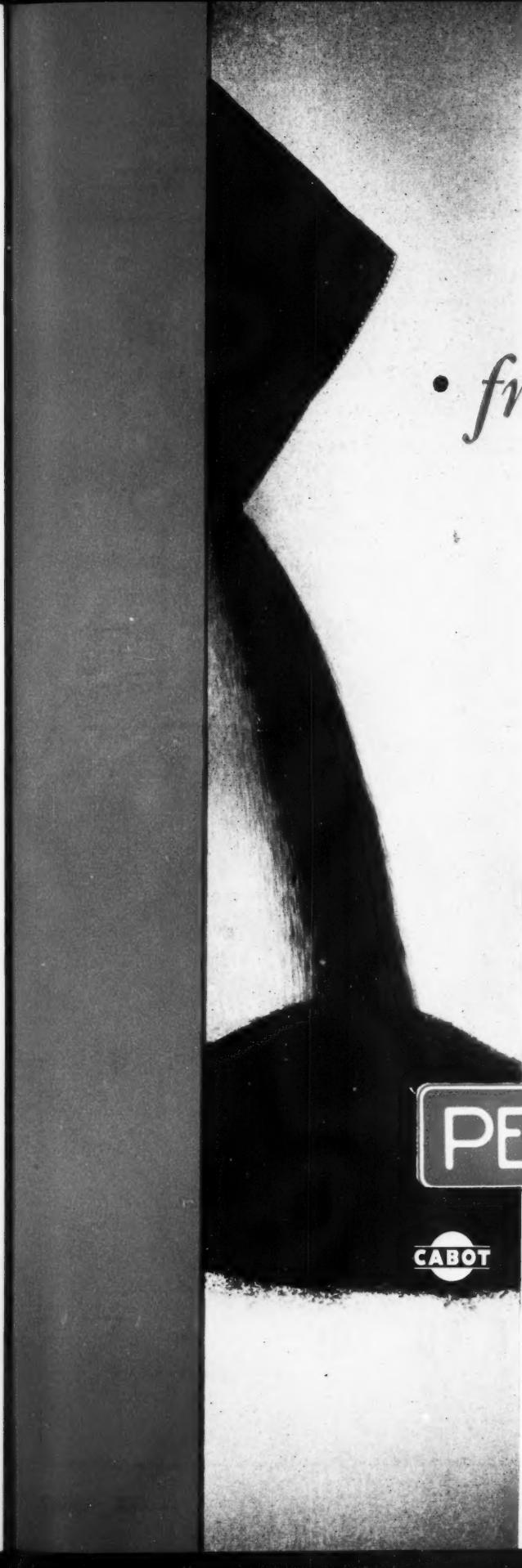
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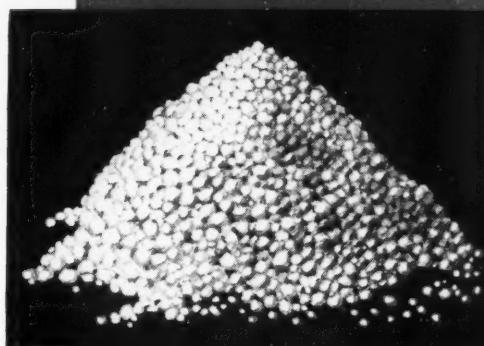
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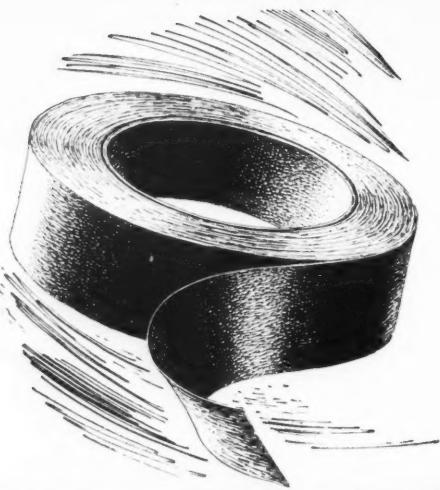
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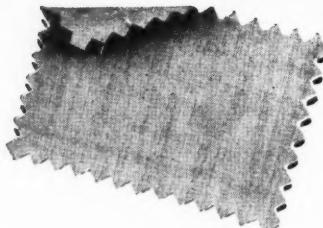
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throughout, you'll find Columbus sheeting a versatile performer for your needs.

Additional Wellington Sears fabrics for coating, specialties and mechanical rubber goods are listed at right. Your nearest Wellington Sears sales office will supply you with full information on your rubber-and-fabric requirements.

An illustrated 24-page booklet filled with valuable facts on fabric development and applications of interest to present and potential users of industrial fabrics is yours for the asking. Write for a free copy of "Modern Textiles for Industry" to Wellington Sears Co., Dept. K5, 65 Worth Street, New York 13.

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The white reinforcing pigment Hi-Sil, a hydrated silica, is known throughout the rubber industry for the superior properties it imparts to non-black goods. It is accepted as standard where highest quality is imperative.

Now, tests just completed using the new Hi-Sil "C" reveal startling increases over regular Hi-Sil, especially in tensile and tear. Following are the test results.



NATURAL RUBBER (Cures at 287°F)

	RECIPE			Pigment	Cure	Modulus 300%	Tensile	Elongation	H	Tear
No. 1 RSS	100	DOTG	1.2	HI-SIL	10	2110	3630	470	68	610
Zinc Oxide	5	Stearic Acid	3		15	2200	3390	440	68	580
PBNA	1	Triethanolamine	1		30	2110	3110	420	72	520
Sulfur	3	Pigment (30 vol.)	58.5		10	1230	3530	620	68	780
MBTS	0.8				15	1380	3660	620	72	800
					30	1450	3550	580	76	710

GR-S (Cures at 280°F)

	RECIPE			Pigment	Cure	Modulus 300%	Tensile	Elongation	H:0"	H:30"	Tear
GR-S 1000	100	TMTDS	0.15	HI-SIL	15	750	2570	630	66	56	180
Zinc Oxide	5	Diethylene Glycol	3.5		30	840	2520	580	66	57	170
PBNA	1	100°C. m.p. coumarone			60	790	2480	560	67	60	150
Sulfur	3	Indene resin	15		15	650	3300	720	68	57	340
MBTS	1.2	Pigment (30 vol.)	58.5		30	900	3400	590	76	66	320
					60	975	3300	575	77	67	290

LTP (Cures at 280°F)

	RECIPE			Pigment	Cure	Modulus 300%	Tensile	Elongation	H:0"	H:30"	Tear
GR-S 1500	100	Triethanolamine	1	HI-SIL	30	890	3190	720	58	53	230
Zinc Oxide	5	Stearic Acid	3		45	940	3220	680	60	54	230
PBNA	1	100°C. m.p. coumarone			60	880	3190	660	60	55	230
Sulfur	3	Indene resin	10		30	440	3570	760	62	55	350
MBTS	0.75	Pigment (30 vol.)	58.5		45	610	3760	700	64	58	340
DOTG	1.5				60	680	3570	660	65	60	360

GR-I (Cures at 307°F)

	RECIPE			Pigment	Cure	Modulus 500%	Tensile	Elongation	H:0"	H:30"	Tear
GR-I	100	Zenite	1	HI-SIL	10	440	1960	850	44	35	210
Zinc Oxide	5	BxDc	1		20	640	2230	780	47	39	150
Sulfur	2	Diethylene Glycol	2.5		60	1020	1600	600	50	43	110
Tellurac	1	Pigment (20 vol.)	39		10	340	2310	940	47	38	310
					20	530	2680	860	50	42	260
					60	980	2300	670	53	47	170

NEOPRENE (Cures at 287°F)

	RECIPE			Pigment	Cure	Modulus 300%	Tensile	Elongation	H:0"	H:30"	Tear
Neoprene GN	100	MBTS	1	HI-SIL	30	720	1600	630	57	43	220
Zinc Oxide	5	Sodium Acetate	1		45	1250	2610	610	57	53	360
PBNA	1	Light Process Oil	10		60	1290	2260	540	56	53	390
ELC Magnesia	4	Pigment (20 vol.)	39		30	1400	3060	620	57	53	480
					45	1570	3260	570	58	55	500
					60	1500	3080	580	60	57	460

Sample quantities of Hi-Sil "C" are available for your evaluation. Limited commercial shipments are ready from our interim plant production. Contact our Pittsburgh office.

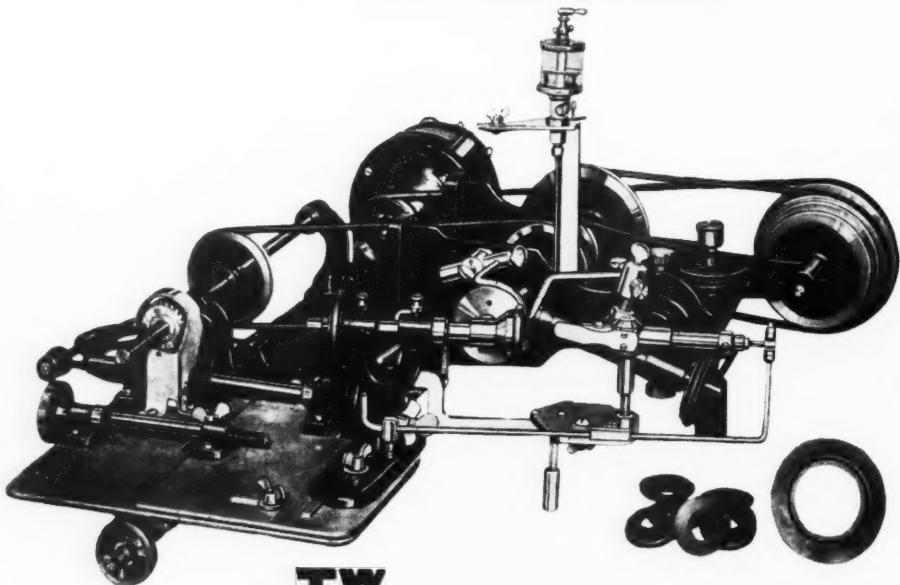


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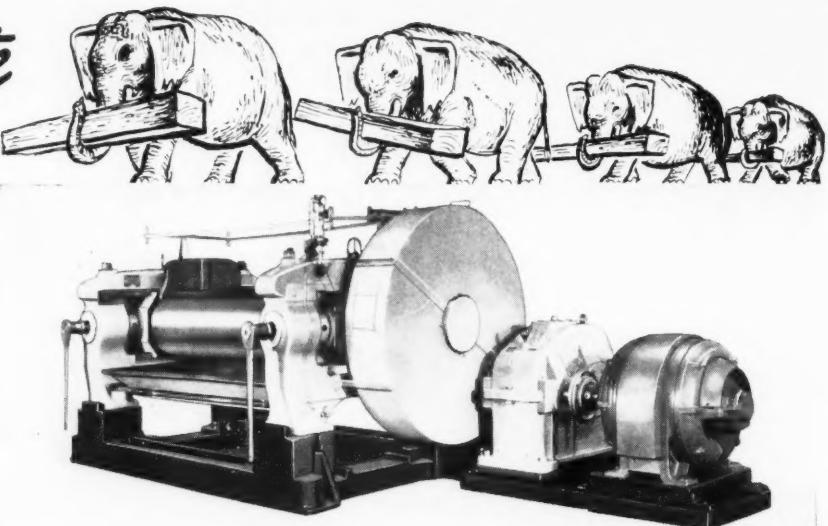
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HEAVY DUTY!

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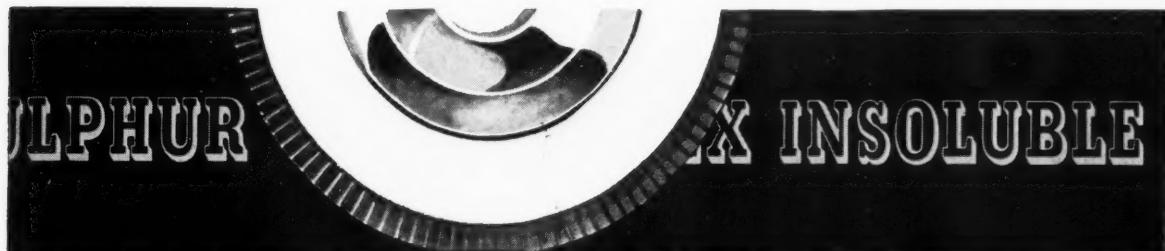
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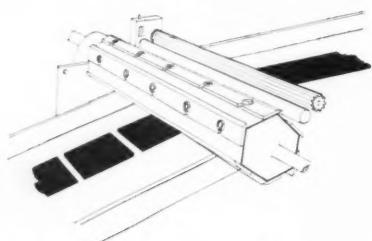


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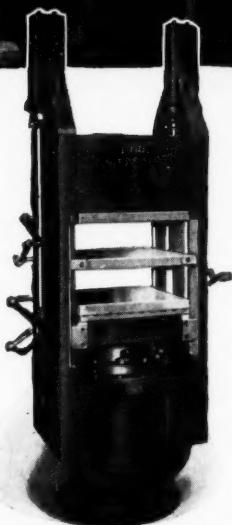
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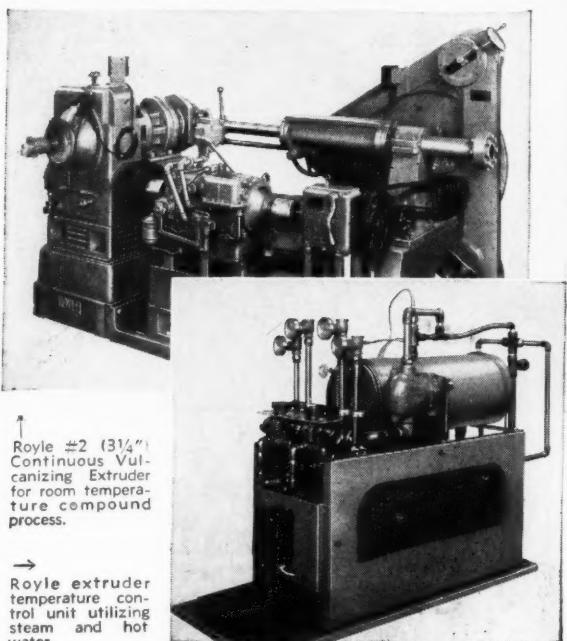
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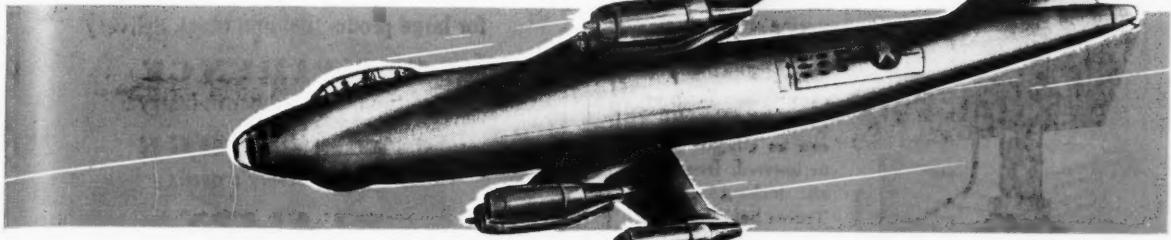
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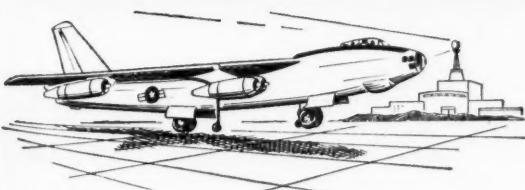
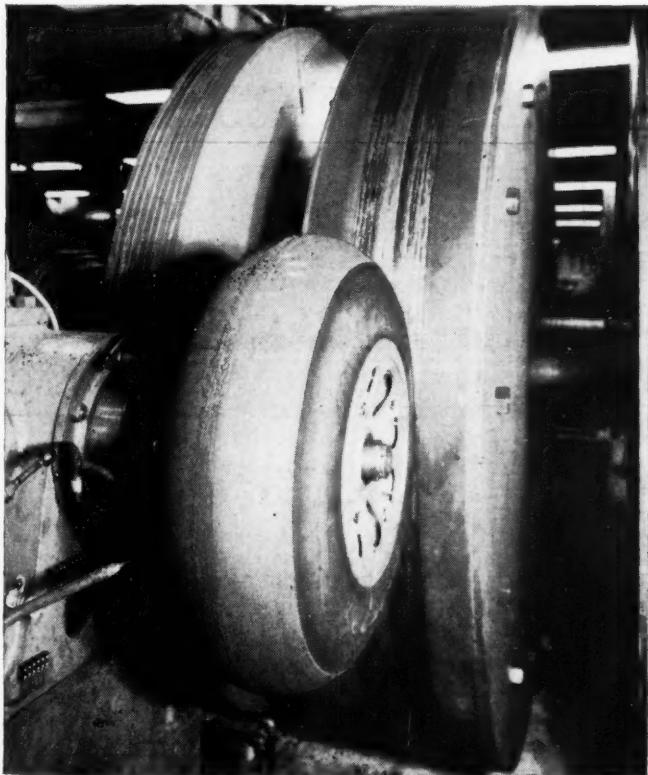


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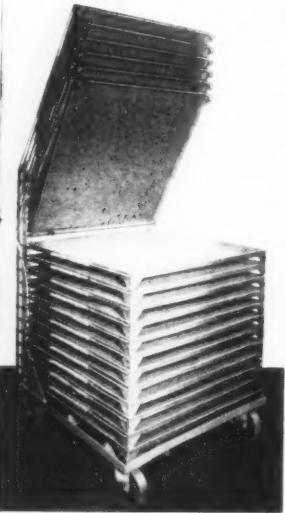
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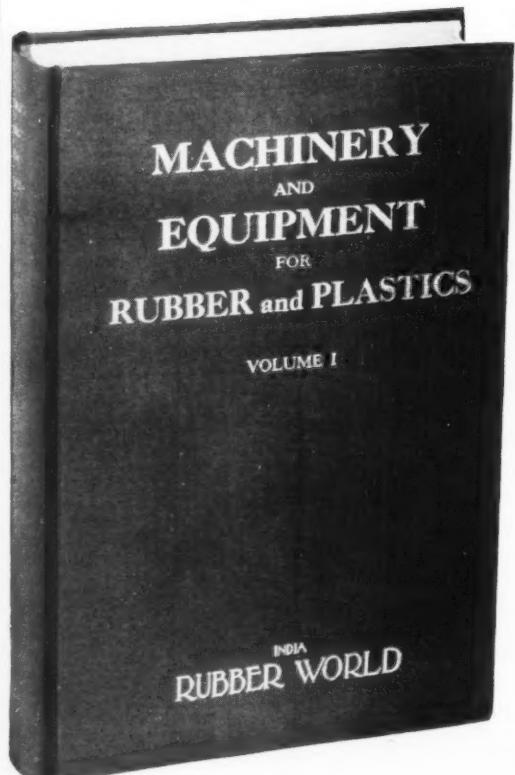
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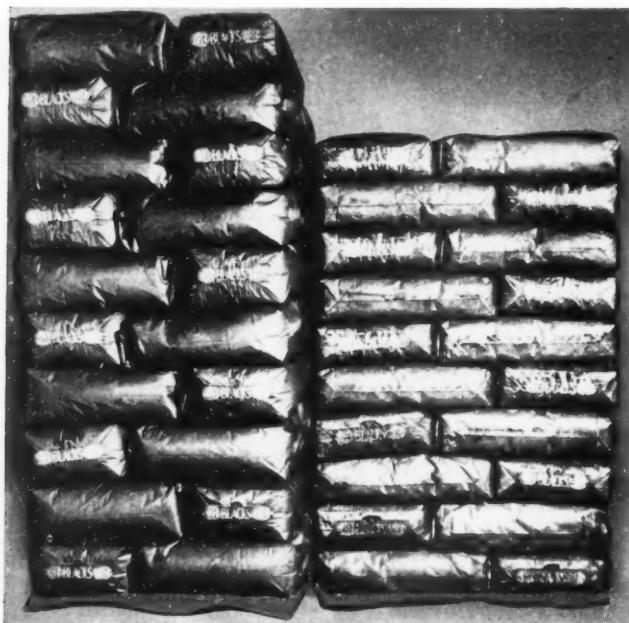
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J. M. Huber Corporation Adopts New Valve-Type Bags for Unique Loads

New York, N. Y.—A new valve-type bag that gives more stable, more compact unit load shipments of carbon black, with a substantial saving in space, was announced today by J. M. Huber Corporation, 100 Park Ave., New York, manufacturers of carbon blacks, clays and rubber chemicals.

Carbon black unit loads made up with the new bags (above) are not only more stable but also easier to handle than similar old-style loads. A 2500-pound unit load of fifty, 50-pound valve-type bags is only 69 inches high in contrast to 84 inches for a unit load of conventional bags. Other load dimensions are approximately the same. Total volume of a

new-style unit load is 95 cu. ft. contrasted to 108 cu. ft. The new bags also stack better.

There is an 18 percent saving in height with the new unit loads and overall volume saving of 12 percent. Whether the black is received in unit or loose bag loads, these savings still accrue. This means significant space saving in the customer's plant where the bags are stored for future use.

The new valve-type bags are currently available in carload and truckload shipments for all of Huber's channel blacks. Development work is in progress on a similar package for Huber furnace blacks.

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A Bill Brothers Publication

JANUARY, 1953

Vol. 127—No. 4

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Plasticizers for Elastomers¹

THE plasticizer literature is a large and growing body of references on the application of almost every conceivable type of chemical structure to the various modifications of high polymeric systems. There is no easy way to classify this wide variety of structures, as is shown by the recent definition proposed by the Committee on Nomenclature, International Union of Pure & Applied Chemistry:²

"A plasticizer or softener is a substance or material incorporated in a material (usually a plastic or an elastomer) to increase its flexibility, workability, or distensibility. A plasticizer may reduce the melt viscosity, lower the temperature of a second-order transition, or lower the elastic modulus of the product."

However, if we are interested primarily in practical compounding, our problem is simplified, narrowing down to the hundred or so plasticizers whose importance in the trade is attested by their purchase in significantly large quantities. These products are listed in Table I.

TABLE I. PLASTICIZERS	
A. Esters	
1. Adipates	
2. Azelates	
3. Sebacates	
4. Phthalates	
5. Phosphates	
6. Fatty Acid Esters	
7. Aconitates	
8. Citrates	
B. Resins	
1. Alkyds	
2. Coumarone-Indene	
3. Factice	
4. Rosin Derivatives	
5. Rubber Derivatives	
6. Miscellaneous	
C. Coal-Tar Products	
Mainly Higher Distillate Fractions and Residues.	
D. Petroleum Products	
Mainly Unsaturated and Cyclized Fractions as from Cracking and Isomerizing Operations and Residues.	
E. Halogenated Hydrocarbons	
F. Miscellaneous	
Including Ethers, Acetals, Nitriles and Amides.	

It should be noted that of all these, the ester type has grown so predominantly to be the plasticizer of choice that it now constitutes about 90% of the total United States production.

The number of distinctly new major plasticizers has not kept pace with the phenomenal increase in volume experienced in this industry in the past decade. The U. S. production of plasticizers grew from 53 million pounds in 1941 to 280 million pounds in 1951.⁴ By far

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the major reason for this growth was the swelling boom in a new industry based on the finding that when suitable plasticizers were added to rigid polymers from vinyl chloride and its copolymers, highly useful elastomeric products resulted.

From a historical point of view the earliest plasticizers used were, of necessity, natural products or simple compounds that happened to be present on the industrial scene. With the vast domestic growth of the synthetic organic chemical industry, a wide variety of new structures has been made available, and we are beginning to approach more closely the ideal of "tailor-made" plasticizers.

An elastomer is defined⁴ as a "material which will stretch repeatedly to 150% or more and will return rapidly and with force to its approximate original shape." A number of high-molecular weight substances fulfill this requirement, and Figure 1 shows the more important of the commercial elastomers.

Physical Basis for Plasticizer Action

What are the structural features that make it possible for an elastomer to undergo high elongation and rapid retraction? From many lines of evidence we conclude that an elastomer consists of long, thread-like molecules which, in the unstressed state, are more or less randomly arranged and which are joined to each other at widely separate points, giving to the whole a gel structure. The connections between the chains may be generally one of three types: namely, (a) chemical union, as in rubber by vulcanization with sulphur, (b) strong associative or secondary valence bonds, as in polyvinyl chloride. If the spatial configuration permits, these strong associative forces may lead to local crystallization, forming crystallites along the chains; and (c) mechan-

¹ Based on talks given before the Connecticut Rubber Group on May 9, 1952, and the Boston Rubber Group on Oct. 17, 1952.

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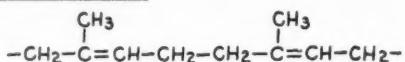
³ *L. Polymer Sci.*, 8, 257 (1952).

⁴ "Synthetic Organic Chemicals, United States Production and Sales," United States Tariff Commission Report No. 173, Second Series p. 44, United States Government Printing Office, Washington.

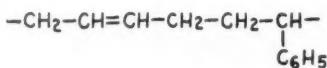
⁵ E. R. Bartholomew, AF Technical Report No. 5891, "Investigation of Rubber Plasticizers for Low Temperature Applications," Wright Air Development Center, Dayton, O.

ELASTOMERS

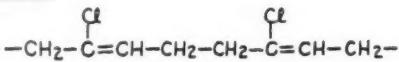
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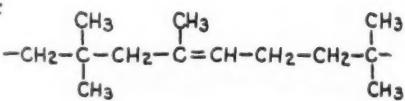
GR-S



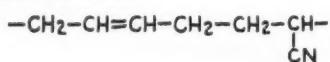
NEOPRENE



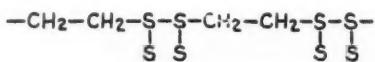
BUTYL



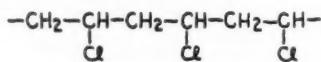
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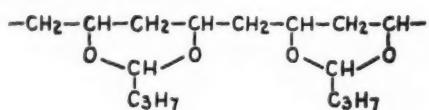
THIOKOL



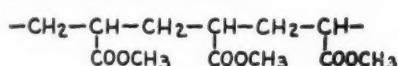
POLYVINYL CHLORIDE



POLYVINYL BUTYRAL



POLYMETHYL ACRYLATE



SILICONE

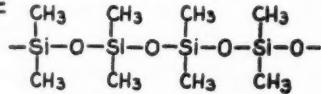


Fig. 1. Some of the More Important Elastomers

reduced that the remaining attached areas act only as connections between the violently vibrating chains.

Association Complexes

Thus one of the effects produced by the plasticizer is to neutralize much of the cohesive force between

ical entanglement, as in high molecular weight polyisobutylene, where owing to the extreme length of the chains, they do not become disentangled during the time interval for normal extension.

Regardless of the type of connection, its effect is to provide "memory" to the system. Thus, when a sample is stretched, the chains are aligned to an extent permitted by the free portions of the chains between the connections. This condition is shown in Figure 2.

The connections prevent the chains from slipping *i.e.* one another as in pure plastic flow, and the application of a force greater than the tensile strength causes actual rupture of the specimen. If, however, the stress is released before rupture, the connections between the chains insure that the original dimensions are essentially resumed.

What causes the chains to retract to their original positions on release of the stress? The kinetic theory offers the best explanation for this action. At ordinary temperatures, there is quite a lot of heat energy in any form of matter. In a liquid, this is primarily in the form of kinetic energy whereby each molecule is moving very rapidly back and forth, changing directions each time it collides with another molecule. This phenomenon gives rise to the Brownian movement so well known and clearly observed when insoluble particles of the proper dimensions are suspended in a liquid. In an elastomer this same violent motion is imparted to the segments of the chains which are free to move. As a result of this continuous bombardment, chains will take up the positions corresponding to the most random distributions permitted by the entanglements and connections between chains. When a tensile stress is applied, and the chains are lined up, the violence of the chain vibrations due to heat energy is forcibly restricted, and this action accounts for the Joule effect so well known in rubber, wherein heat is given off on stretching. When the stress is released, the restrictive force on the heat kinetic motions is removed, and the chain segments resume their previous violent lateral motions, resulting in a resumption of the original random distribution and original dimensions.

Plasticization of Polyvinyl Chloride

We should certainly expect of a good plasticizer for elastomers that it would improve elastomeric qualities as shown by this type of physical behavior. This point is perhaps best illustrated by considering how a plasticizer can convert a rigid plastic like polyvinyl chloride into an elastomer.

At room temperature, polyvinyl chloride is rigid because it has a high concentration of chlorine atoms strung along the chains. These polar centers exert strong cohesive forces which hold the chains firmly together. The kinetic energy at ordinary temperatures is not sufficient to knock the chains apart and keep them apart. However, if we heat the material, we can put enough heat kinetic energy into it to overcome the cohesive forces. If we heat polyvinyl chloride to above its melting point, we produce large vibrations between the chains, and now we find that we can work in suitable plasticizers. On cooling to room temperature, the combination of plasticizer and resin retains its elastomeric condition. Quite apparently the plasticizer has forced its way sufficiently between the chains to free large segments thereof, which now respond to the heat kinetic bombardment at room temperature by large amplitude movements as in a liquid. The net effect is that the restrictive cohesive force between the chains has been so

chains. In order to do this neutralizing it is necessary for the plasticizer to form association complexes with the force centers on the chains. These complexes should be at least as strong and preferably stronger than the bonds which would tend to tie the chains together. With polyvinyl chloride it is essential, therefore, that a good plasticizer contain a minimum concentration of effective groups which can form association complexes with the chains. Such effective groups have been found to be ester, aromatic ring, ketone, phosphate, ether, and halogen groups.

If the cohesive forces between chains are significantly greater than the forces between the chains and plasticizers, then on aging, the polyvinyl chloride molecules will increasingly cleave to each other, forcing the plasticizer out. On the other hand, it is not always desirable for the plasticizer to form too strong attachments with the chains, which would thus tend to give the effect of fixed side-chains. The plasticizer molecules are large and bulky compared with the segments of the polymer chain, and the formation of fixed bulky side-chains would greatly restrict the necessary motions of the chain segments. This condition would lead to much interlocking of chains, producing rigid systems.

It seems clear, therefore, that for optimum elastomeric behavior, there should be a desirable balance in a plasticizer molecule between groups producing strong associative complexes and non-associative groupings. This is borne out in practice by such good elastomeric plasticizers as dibutyl sebacate, dioctyl phthalate, and the like. These plasticizers are distinguished for their balance between associative groups such as ester and aromatic

rings on the one hand, and non-associative groups, such as aliphatic hydrocarbon, on the other hand.

The structural arrangement of these groups in a plasticizer is also of great importance, but has not received the attention it merits. Nevertheless it is easy to see that in a typical dynamic elastomeric system, the effectiveness of an associative group, such as ester, will depend upon its availability for attachment to the polymer chain. If an ester group is surrounded by bulky side-chains, its ability to make effective contacts with polar centers on the chains is greatly reduced. Also bulky side-chains will tend to interfere with the ease with which plasticizer molecules can slip by one another.

Our picture of a plasticized elastomer is one, then, of a gel-like, self-contained bag of liquid. The long, thread-like molecules are in violent agitation, being restricted by connections at intervals along the threads. Plasticizer molecules and polymer chain segments are constantly bouncing into each other, being held momentarily when the respective secondary-force centers come into contact. The complexes formed are weak, however, and break apart readily under further thermal agitation, only to reform with other similar molecules or chain segments. This dynamic, continual making and breaking of the association complexes permit the plasticizer molecules to diffuse throughout the entire mass, similar in this way to the behavior of a pure liquid.

The elastic modulus of such a system is low, and deformation occurs readily. On application of a stress, the chains move easily with a minimum of friction from a series of contacts with one group of plasticizer molecules to an equivalent series of contacts with a similar group of plasticizer molecules. On relaxing the stress, the reverse of this action occurs. The main change in energetics in such a system before and after stress application resolves itself to the physical restriction of thermal agitation of the chain segments, similar in this way to the elastomeric behavior of unplasticized rubber.

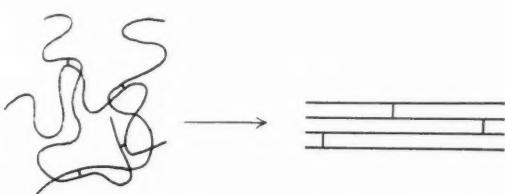


Fig. 2. Schematic Diagram of Randomly Distributed Polymer Chains and More Ordered Chains after Stretching of Polymer

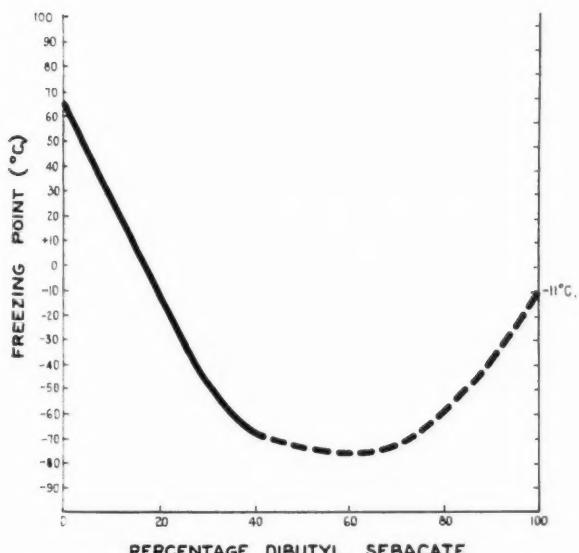


Fig. 3. Freezing Points of Polyvinyl Chloride Plasticized with Dibutyl Sebacate

tive structures such as aliphatic hydrocarbon for minimum frictional resistance. Also, it appears clear that the least frictional resistance would be offered by straight chain structures, rather than highly branched chain structures, and this point is confirmed by practical results.

General Compounding

We have discussed how a plasticizer operates. What about the selection of a plasticizer to meet a specific, practical compounding requirement? What particular qualities should one look for in a plasticizer? These can be divided into two groups, necessary and desirable.

Necessary Qualities of a Good Plasticizer

1. AVAILABILITY. No matter how attractive a product may seem on paper, or in laboratory tests, the practical compounder must first of all determine whether the plasticizer will be available in the quantities he will need in production at the necessary times. If not, the product should be given a research status, and work on it should be clearly understood to be an investment for the future.

2. PERMANENCE. The plasticizer should remain in the goods, and elastomeric properties should remain essentially unchanged during the expected useful life of the finished item. This requirement generally reduces to the following properties of a plasticizer:

a. Volatility. This should be so low that no more than traces of the plasticizer are lost during the useful life of the product. Practicable ranges will vary, depending upon the percentage of plasticizer used, thickness of the goods, and service conditions, but in general very few acceptable products will be found with molecular weights below 300.

b. Compatibility. Plasticizers must, of course, be compatible. For new and unfamiliar products, this property can be determined by trial and error methods, but it certainly helps to know what has worked in the past and to use as much as possible a knowledge of the relations between chemical structure and compatibility such as have been discussed in the previous section.

It is important to keep in mind at all times that we are trying to maintain a homogeneous, one-phase liquid-type solution, and that injudicious addition of incompatible ingredients, even in traces, may cause the system to break up into two or more phases. As an analogy, it is well known that benzene and alcohol form perfectly stable, homogeneous solutions. If one wanted to preserve a benzene-alcohol solution, one would be very cautious about adding water, for it wouldn't take much to cause the solution to fall apart into two phases.

Yet there are many instances in plasticizer compounding when similar situations are precipitated by adding traces of "this and that" for processing or other reasons. The effect of the additives on compatibility is often ignored, when in truth they may be as harmful to stability as the addition of water to benzene-alcohol solutions. Exudation has often been erroneously blamed on a lack of plasticizer compatibility when a small amount of additive was actually the responsible factor. When it becomes necessary to add incompatible substances for special reasons, attempts should be made to compensate for these by the use of substances of extra solvency.

One of the best of the semi-quantitative methods of measuring compatibility of a plasticizer involves the immersion of a test specimen of the unplasticized elastomer in the pure plasticizer and allowing it to stand at a temperature which depends upon the particular elastomer.^{5,6} If the plasticizer is compatible, it will work its

way into the elastomer specimen and produce swelling. A rough idea of the degree of comparative compatibility may be obtained from the relative amounts of swelling.

c. Aging Resistance. The plasticizer should not contribute unduly to the deterioration of the finished article under the forces which will act on it during its normal life. These generally involve such forces as ultra-violet light, heat, air, and extraction by various media, including water, soapy water, mineral and vegetable oils, etc. For many items in the vinyl elastomer field, the conditions of use may vary widely, and it is often necessary to provide good resistance to extraction to more than one of these media. For specific applications certain requirements become obvious. For shower curtains or garden hose, for example, good water resistance is a prime requisite.

Laboratory (accelerated) tests for extraction performance qualities are easily obtained and are reliable as a rule. Accelerated tests for outdoor weathering or for various combinations of exposure to heat, ultra-violet light, and air are also very useful, but should not be used to the exclusion of actual use tests. It is extremely difficult to duplicate actual use conditions in the laboratory, and the deterioration of the elastomer depends intimately on the specific conditions encountered. One of the major changes which can occur is embrittlement due to oxidation and cross-linking of the elastomer. As a result, it tends to lose long-range elasticity, and becomes more and more insoluble. This type of action also reduces its compatibility and may lead to exudation of plasticizer or stabilizer, etc. With some elastomers, continued oxidation may lead ultimately to chain scission and degradation, with great loss in strength properties. To minimize these effects, there is a growing use of age-resistors and avoidance of substances which will promote oxidation.

It is always most desirable to be able to run full-term aging tests, but for routine work time is often very short, and here accelerated tests have great value. I believe, however, that actual service tests, even if only for short times, should be run wherever possible on products which are going into actual production. The nature of the actual use is sometimes so different from the accelerated weathering test that even a short actual use test gives valuable results. A good example of this is the hanging of vinyl drapery film behind glass in a window. A major value of short actual use tests is that they will show up any serious fault in the compound that may have been overlooked and that isn't revealed by accelerated tests. As a practical matter, it is the occasional "bad actor" which shows up early in use which is actually of much more concern to the customer than whether the product lasts four rather than five years.

Desirable Qualities of a Good Plasticizer

1. Low Cost. It is axiomatic that the lower the cost the wider the field of application is for any plasticizer. The industry is competitive, not only as among manufacturers of the same product, but also as among different base materials, i.e., vinyl and rubber, vinyls and cotton, etc. Costs are therefore of utmost importance in determining whether an elastomer can make a sizable impression in an established field.

It is not to be assumed from this statement that a necessary or highly desirable quality can be sacrificed for price. The history of the industry has clearly demonstrated that as a rule inadequate or significantly inferior plasticizers will be rejected even when they are much

^{5,6} H. Jones, Ministry of Supply (England) Bulletin No. 8/46, "Plasticizer-Polymer Interaction," 1946 (Geigy Co., Ltd., Manchester, England).

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cheaper, except perhaps in times of direst scarcity. The major reason for this practice is that there are too many complaints from the ultimate consumers.

2. GOOD COLOR. The problems here are continually lessening, as the manufacturers improve their methods. Most of the major plasticizers are light yellow or water-white in color. The original color is generally not so important as color stability during processing and uniformity of pigmenting value from batch to batch.

3. GOOD ODOR. This characteristic is very important, particularly since most plasticizers have some degree of odor. "Nasal analysis" of elastomers is a common practice. The major point is to avoid odors which will prove objectional to the ultimate consumer. Since this is a highly subjective matter, it is often difficult to evaluate without actual general consumer tests. The best practice is to strive toward the elimination of all odor.

4. GOOD TASTE. This requirement is particularly important in products which come into contact with foods.

5. NON-TOXICITY. This is also of great importance and is, of course, a "must" where foodstuffs may be encountered. The methods of test are very lengthy and expensive, and much more work needs to be done. In connection with this quality, low extractability by the foodstuffs is a desirable quality.

6. MILDEW-RESISTANCE. Of particular importance in the warmer, more humid climates, it is sometimes difficult to reconcile this quality with non-toxicity, since toxicity to humans and toxicity to microorganisms producing mildew generally run parallel.

7. NON-INFLAMMABILITY. For many applications the product must not be inflammable. Phosphate and halogen-containing plasticizers can be used to help confer this property on the composition.

8. NON-MIGRATORY. In certain applications, this quality is of great importance, as for example, where the elastomer is held in contact with other organic materials for prolonged times, such as polyethylene, polystyrene, paints, lacquers, and the like. In these instances deterioration of the other material may occur through absorption of the plasticizer.

The best tests to use here are service tests, where plasticizers satisfactory in every other way are subjected to tests simulating actual use.

The so-called "resinous" or "polymeric" class of plasticizers has worked out to good advantage here. These products are characterized by higher molecular weights and higher viscosities than the usual plasticizer types. In contrast to the typical plasticizers, which are generally fairly pure individual chemicals, the "resinous" products are mixtures of a wide variety of different chemical species, usually including low molecular weight as well as high molecular weight materials. Because of this condition close production controls are necessary to insure uniformity from batch to batch.

Migratory tendencies of a plasticizer from one material to another will depend primarily upon two factors: namely, (a) length of time of contact of the two materials, and (b) relative solubility of the plasticizer in the two materials. For short contact times the viscosity of the plasticizer will probably play the dominant role, and it is here that "resinous" plasticizers demonstrate their greatest merit. The rate of movement of plasticizers across the interface is a direct function of the viscosity; therefore "resinous" or other plasticizers of high viscosity will show less effect in comparable times than plasticizers of low viscosity which can move across the interface quite rapidly and as a result show effects sooner on the other materials. For long contact times, however, the rate factor in achieving interface equilibrium may

become of less importance than the relative affinity of the plasticizer for the two systems. Under these circumstances it would not be at all surprising to find instances where "resinous" plasticizers show more total migration than many non-resinous plasticizers.

9. GOOD HEAT RESISTANCE. This characteristic is increasingly more desirable, particularly in the plastics industry which constantly seeks to use higher production temperatures to produce faster production rates. Most of the progress here, however, has come by the development of superior heat stabilizing systems. These better stabilizers have also helped widen the applicability of plasticizers of inherently poor heat stability.

10. EFFICIENCY. As a rule, efficiency is tied in with cost. For plasticizers which are more expensive than the pure elastomer, it is generally desirable to use the minimum quantity which will achieve the desired physical properties. For plasticizers which are significantly cheaper than the base polymer, it may be economically advantageous to use as much of the plasticizer as possible without injuring product quality. In such a case, low efficiency of the plasticizer might be desirable.

11. ELECTRICAL PROPERTIES. For electrical applications, qualities such as resistivity and power factor are important. Most pure chemical plasticizers have good electrical properties. Small amounts of impurities, however, can be very damaging here, and it is usually necessary to take special precautions in refining plasticizers to insure that they will be suitable for electrical applications.

12. MISCELLANEOUS. Many other qualities may be classified as desirable, including processing behavior, effect on cure, non-croaking, non-bleeding, heat blocking resistance, heat sealability, compatibility with colors and other ingredients, static resistance, etc., but these become less primary characteristics of a true plasticizer and more dependent on the other ingredients of the compound and the specific processing conditions.

There is, however, one very highly desirable quality of a good plasticizer which is of constant interest and concern, and that is its ability to maintain physical characteristics of an elastomer over the widest temperature range. This involves primarily resistance to embrittlement at low temperatures.

Low-Temperature Properties of a Plasticizer

The retention of elastomeric properties in the cold is, of course, of vital importance for military applications such as in Korean winters, or activities in the polar regions or in the upper reaches of our atmosphere. Undue stiffening, loss of resilience, or cracking of parts may result in equipment failures and increased casualties.

Even for the most "civilian" of uses, however, it is true that changes in physical characteristics of finished goods with change in temperature are generally highly undesirable.

Different elastomers will show different responses in degree of stiffening in the cold. With any one particular elastomer, the degree of stiffening is largely determined by the amount and the nature of the plasticizer used. By suitable choice of plasticizer, enormous differences can be achieved in the range of useful service temperatures of the finished goods.

In the building of a compound for low-temperature service, the nature of the elastomer is our first consideration. Table 2 lists the approximate freezing points of most of the high polymers used in commercial elastomers. There is a range of over 140° C. in freezing points. The polymers with freezing points above room temperature are rigid plastics, but are converted into elastomers by incorporation of suitable plasticizers. In general, there

is a rough correlation between the freezing point and the amount of plasticizer required to develop good low-temperature properties: namely, the higher the freezing point of the pure polymer, the more plasticizer is necessary.

TABLE 2. APPROXIMATE FREEZING POINTS OF POLYMERS

Polymer	Freezing Point (°C.)
Polyisobutylene	-74
Natural Rubber	-73
Polybutadiene	-68
GR-S	-61
Butadiene-Acrylonitrile	-20 to -50
Neoprene	-20 to -40
"Thikol" St	-50
Polyethyl Acrylate	+3
Polyvinyl Butyral	+30
Polyvinyl Chloride	+70

With any particular polymer, which may be specified by other considerations, how can we select a plasticizer to give the best low-temperature performance? If we take polyvinyl chloride, for example, we might make up large numbers of compounds with different plasticizers and determine changes in such properties as hardness, modulus, extensibility, stiffness, crack resistance on bending, resilience, torsional resistance, permanent set, "hand," etc. on exposure in a cold box or other environment duplicating the anticipated cold service condition. We would find that some plasticizers are greatly superior to others in minimizing the amounts of change that occurred with change in temperature.

If we study the plasticizers that give the best low-temperature behavior, we note that there are three characteristics that they seem to have in common. These are low viscosity, high viscosity index,⁷ and intermediate compatibility.

We have already indicated that for optimum elastomeric behavior a plasticizer should be of an intermediate range of compatibility. If it is incompatible, obviously it cannot be used. If it is too compatible, in the sense of forming very strong plasticizer-polymer attachments, the plasticizer molecules become too firmly attached, and elastomeric movements of the chains become restricted owing to the interlocking effect of the bulky plasticizer pseudo "side-chains." Something in between these extremes of compatibility is most desirable, wherein the plasticizers make only weak attachments, and the chains can easily move under stress from one set of plasticizer contacts to another.

With plasticizers of intermediate compatibility, low-temperature flexibility of a plasticized elastomer is determined by its viscosity at the test temperature, and this is largely determined by the viscosity of the plasticizer.⁸ A low-plasticizer viscosity insures the greatest mobility of the chains, and a high-viscosity index insures that there will be the minimum increase in viscosity of the plasticizer on lowering the temperature.

Table 3 shows some results with a group of typical low-temperature plasticizers for polyvinyl chloride compared with some standard, non-low temperature plasticizers. It is to be noted that all of the good low-temperature plasticizers have low viscosities (around 10 centistokes at 100° F.) and high viscosity indexes (90 or more).

This table also lists the freezing points of the pure plasticizers. A prior reasoning would indicate that the lower the freezing point of the pure plasticizer, the better it is for low-temperature performance. The table shows that this certainly cannot be accepted as a generality. Some of the best low-temperature plasticizers have relatively high freezing points.

For example, dibutyl sebacate is well known to be one of the very best low-temperature plasticizers; yet it freezes at -11° C. Figure 3 shows what happens to the freezing point when dibutyl sebacate is blended with polyvinyl chloride. The blends are found to have greatly depressed freezing points, with certain compositions below -70° C. The simplest explanation appears to be that this example is one of typical eutectic behavior, as is commonly observed between most dissimilar organic chemicals. It is also very likely that the freezing point of the association complex formed between the plasticizer and the resin must be considered significant here, since the stability and concentration of such complex will undoubtedly increase as the temperature is lowered.

Thus, the determining factor in low-temperature behavior would appear to be not the freezing points of the pure, separate ingredients, but rather the freezing points of such association complexes and eutectic mixtures as they may form.

Where eutectic behavior is found, it would be expected that the addition of plasticizer would produce lower and lower freezing points up to a certain concentration, but that when further amounts of plasticizer are added, the freezing point would not be lowered further, but might even be expected to rise in some cases, owing mainly to the freezing out of the excess plasticizer on holding at the lower cold temperatures. In such instances it can be seen that exceeding the optimum concentration of plasticizer might actually worsen the low-temperature properties of the compound.

Larger freezing-point depressions would be anticipated in mixtures of structurally dissimilar organic compounds than when similar materials are mixed. This point is undoubtedly favored by the opportunities for attractions between the different force centers. With high molecular weight polymers in particular, the attractions would favor the stability of the irregular polymer-plasticizer clusters and thereby reduce the tendencies of the polymer or plasticizer to crystallize separately. Thus we would expect greater opportunities for large freezing-point depressions with strongly polar polymers such as polyvinyl chloride, neoprene, and high-acrylonitrile rubbers than with purely hydrocarbon-type polymers, such as polyisobutylene, and polybutadiene, which have only weak associative forces.

Where no complex formation or eutectic behavior is found, one would expect that the freezing point of the pure plasticizer would be more significant in determining the stiffening characteristics of the plasticized elastomer. In such instances, if the compound is held at a temperature appreciably below the freezing point of the pure plasticizer, and if the latter is present in a fairly high concentration, then partial crystallization of the plasticizer would be expected, producing rigidity or at least some stiffness.

Even in such cases, however, the advantages of eutectic behavior can be obtained by (a) using lower concentrations of any one crystallizable plasticizer, and (b) us-

(Continued on page 510)

TABLE 3
FREEZING POINTS AND VISCOSITY INDEXES OF PLASTICIZERS FOR POLYVINYL CHLORIDE

Plasticizer	Freezing Point (°C.)	Viscosity at 100° F. (Centistokes)	Viscosity Index	Freezing Point of Plasticized Vinyl Chloride (50 PHR)
Tricresyl Phosphate	< -35	29.3	-19	-9° C.
Dioctyl Phthalate	-50	29.7	19	-34
Dibutyl Phthalate	-35	9.6	37	-30
Triocetyl Phosphate	-80	8.2	94	-60
Dicapryl Adipate	-15	8.3	120	-60
Dioctyl Adipate	< -70	8.2	121	-60
Sebacate	-55	12.9	152	-60
Dibutyl Sebacate	-11	6.1	157	-65

⁷ "The viscosity index is an empirical number indicating the effect of change of temperature on the viscosity of an oil. A low viscosity index signifies relatively large change of viscosity with temperature." ASTM D567-41, "A.S.T.M. Standards, 1949, Part 5," p. 943. American Society for Testing Materials, Philadelphia (1949).

⁸ H. Jones, *Trans. Inst. Rubber Ind.*, 21, 298 (1946).

A Survey on Dirt Content of Natural Rubber

K. F. Heinisch²

IN VIEW of the high service requirements for most rubber goods, it is imperative that the quality of natural rubber in regard to uniformity and cleanliness be raised to the highest possible level within the shortest possible time. The dirt content of crude natural rubber, in particular the lower grades, has become a really serious problem for rubber consuming industries during the past few years.

In an effort to solve this problem, the Indonesian Rubber Research Institute has for some time been investigating the possibilities of reducing the dirt content of crude natural rubber.

In order to get a general idea of the needs and requirements of the rubber goods manufacturing industry, some information was necessary from the consumers as to the effect of dirt in rubber. For this purpose a questionnaire was drawn up and distributed by Rubber Stichting, Delft, Holland; British Rubber Producers Research Association and British Rubber Development Board, both of London, England; Institut Français du Caoutchouc, Paris, France; The Rubber Manufacturers Association, Inc., New York, N. Y., and American Society for Testing Materials, Philadelphia, Pa.

Within the sphere of activity of the Rubber Stichting, this questionnaire has been answered by 18 firms in Holland, Belgium, Germany, and the Scandinavian countries, and the Rubber Stichting has arranged the answers in a convenient report. From England, eight answers have been received, and from Japan, 11, together with a summary from the Rubber Engineering Association of Japan. From the United States the RMA sent in a summary made up of 10 answers received from members of the crude rubber committee of both the RMA and the ASTM.

The Institut Français du Caoutchouc also forwarded a summary of all answers received from a number of leading rubber goods manufacturers to questions put to them verbally.

The INIRO wishes to thank for their cooperation all the institutes and associations who have assisted in collecting this information and all the rubber goods manufacturers who have shown their interest by sending in their answers.

Summary of Questionnaire Answers

A summary of the above-mentioned answers to the questionnaires showed that they were sometimes in contradiction with one another; furthermore, some questions were answered vaguely and incorrectly. In the latter case this attitude may mean that the consuming industry itself does not as yet have definite opinions on various points. The applications of rubber are so numerous, and the requirements with regard to cleanliness vary according to the final use and the manufacturing process involved. Nevertheless the future market for natural rubber depends on the cleanliness, uniformity of proper-

ties, and good packing of the rubber, and for these reasons the attention of all rubber producers must be drawn to the all important problems in this connection.

It is generally agreed that the quality of crude natural rubber after World War II, especially during the past two years, has greatly deteriorated, and that the rubber contains much more dirt than it did formerly. It appears that in general only the best grades of pale crepe and No. 1 and No. 2 ribbed smoked sheets can be classified as fairly clean rubber.

An accurate definition of harmful dirt according to quantity, particle size, or nature of the dirt, is difficult to give. There is no agreement on the degree of harmfulness of the dirt; the general idea is that this depends on the requirements of the finished products and the manufacturing processes used. In most cases the standard recommended for the amount of harmful dirt is the residue retained on a 325-mesh or 200-mesh (U. S. standards) screen on sieving a rubber solution. The definition of "harmful dirt" as the residue on a 325-mesh screen is in accordance with the definition of the crude rubber subcommittee of Committee D-11 of ASTM, and our own suggestion. Also, it seems quite reasonable to use the 325-mesh sieve in determining the degree of cleanliness of natural rubber, inasmuch as the major compounding ingredients are used with a particle size of about 300 mesh.

The French have given another definition, by which not only all the dirt that is left on a 200-mesh screen, but also the dirt which passes through this screen, if it amounts to more than 0.5%, is considered harmful dirt. This latter definition gives rise to the importance of introducing, in addition to "harmful dirt," the "total dirt content" as a basis, as suggested in some cases.

Where no distinction was made between harmful and harmless dirt, the amount and the particle size of the dirt were the determining factors as to whether or not a rubber might be considered suitable for a specific product. Actually a large amount of dirt of small particle size may cause more harm than a small amount of dirt of large particle size. Limits of allowable dirt and ash content for each RMA type of crude natural rubber, as suggested by the Americans, would therefore seem highly desirable.

Practically all known methods have been recommended for determining dirt content. Some consumers evaluate their rubber according to outward appearances only; while others apply a quantitative method of determination. Preference is shown for the quick, optical methods whereby the number of dirt particles in a certain area or certain weight of a plasticized sample are counted, as a measure of the degree of contamination.

The difficulty encountered in all cases, with the exception of the method where the entire lot is strained through a screen, is that of obtaining a representative sample of a given lot of rubber in which the dirt is distributed in a random manner. A statistical analysis of the distribution of dirt in a large number of samples to determine if there is a possibility of an approved method of sampling might be of much help.

¹ Based on a paper (Bericht No. 214) submitted by the Indonesian Rubber Research Institute, Bogor, Indonesia.
² INIRO, Bogor.

Dirt is generally defined as the particles of foreign matter other than the rubber hydrocarbon and serum substances which can be separated from the rubber by physical methods.

The question regarding the amount of dirt present in various trade grades of rubber was answered only in a few cases. The figures given varied considerably, depending on the method of determination used; therefore a comparison of the figures for the purpose of establishing standards was not possible.

The most common types of contamination found in natural rubber were sand, bark, wood splinters, fibers, gravel, plant fragments, as well as various impurities picked up by bales during transportation, such as grains of rice and maize, coal, etc. In general, both the inorganic and organic types of dirt are considered harmful since either will be detrimental to quality if hard enough to resist breakdown during milling to a particle size considered harmless. It is possible to crush dirt to a certain extent, but most of the time the particles still remain too large in size. There was a marked preference for the open mill as compared to the Banbury mixer for such grinding of dirt particles as might be accomplished during compounding and processing.

The most common difficulties encountered in the processing of crude natural rubber due to dirt occur during extruding, calendering, the processing of thin walled articles, mixing, dipping, and spreading. Articles mentioned as particularly susceptible to damage due to dirt in the rubber were thin walled articles, coated fabrics, inner tubes, tires, insulation, surgical goods, footwear, and hard rubber articles.

The physical and mechanical properties of the finished products which were said to be most adversely affected by dirt were: permeability, electrical properties, tensile strength, fatigue resistance, tear and abrasion resistance, water absorption, elongation, and flex life. Further, the homogeneity of the compound and the appearance of finished products are impaired. Dirt particles act as centers for localized deterioration, sometimes resulting in leaks in rubber containers for gas and liquids, and may even affect adversely the smell of finished products.

In handling and shipping crude natural rubber there is often much possibility for surface contamination with dirt and fibers; such contamination is difficult to remove entirely and results in extra expense. This problem is partly solved by the use of coating materials, but these must be perfectly dispersible. Also, the softer the rubber the more easily it becomes contaminated with surface dirt, and the temperature at which the rubber is stored or shipped should be such that softening due to heat is not experienced.

Packaging in fabrics or jute is not recommended because of the fibers that may become embedded in the rubber. Careless handling of bales resulting in deformation is objectionable since the coating and wrapping sheets may be damaged, and more dirt can therefore enter into the interior of the bales. It has been found that greater care exercised in the packing and coating of bales is a means of insuring lower dirt content.

A large number of rubber goods manufacturers emphasized the fact that objects such as pieces of iron, wood, paper, fragments of textiles, swords, machine gun bullets, and even money, are often found in bales of rubber (even of higher grades) owing to careless handling and shipping. The damage to mixing equipment caused by these objects may be more serious than the effect of excessive dirt.

Several recommendations were made for the use of greater care and better control of operations during all stages of preparation, packing, and handling of crude

natural rubber. Further attention was drawn to the future desirability of a better method of packing than the present bareback bales, such as packing in impregnated fabrics, sheets of artificial materials, vulcanized rubber sheets, etc.

Another point said to require special attention is the coating of the bales with an unsuitable mixture, resulting in unsatisfactory protection of the bale or the formation of a hard layer on the bale surface which will not break up and disperse on milling. The practice of using excessive quantities of talc between the sheets in the bale, although talc is not generally considered as dirt, is certainly objectionable.

Conclusions and Further Work

It is clear that a basis for complaints concerning non-allowable and variable dirt content of bales of crude natural rubber does exist. The most important questions in connection with these complaints cannot, however, be answered satisfactorily from the results of the present questionnaire. The rubber consuming industry is obviously not yet in a position to define clearly its requirements regarding the dirt content of natural rubber.

The following more specific information is required:

1. Definition of the limits of allowable dirt content, subdivided, if necessary, according to end-use of the rubber in question.
2. A standard method of sampling.
3. A standard method of test for dirt, consisting possibly of one official test and several simple routine tests that can be compared with the standard test.

INIRO has the task of indicating how the requirements of the rubber consuming industry with regard to dirt content of natural rubber can be met by the rubber producers. In this connection INIRO thinks it necessary to supply the directives needed in a provisional form.

INIRO has therefore submitted a memorandum to the rubber research institutes cooperating under the aegis of the International Rubber Research Board; in this memorandum a tentative proposal has been made in order to arrive at a suitable "Dirt Content Classification." We hope that after discussions between the institutes have been held, a proposal can be drawn up for publication. At that time, if the rubber consuming industry will report its reactions to the proposal, a generally acceptable scheme may be possible.

Acknowledgment

The author wishes to acknowledge the great interest and valuable suggestions received in this matter from G. J. van der Bie, director of INIRO; H. C. J. de Deckker, director of the research department, Rubber Stichting, Delft, Holland (at present, acting director); and G. E. van Gils, head of the research department, INIRO.

Publications of Burgess Pigment Co., 64 Hamilton St., Paterson 1, N. J.

"Burco-RA." Data Bulletin 52-1. 2 pages. This bulletin gives the properties, characteristics, and applications of the company's new reclaiming agent for use with natural, GR-S, neoprene, and nitrile rubbers. Physical properties of typical reclaim formulations are also included.

"Kenflex Resins." 21 pages. Kenflex resins, made by the Kenrich Corp., are synthetic hydrocarbon polymers available in four grades for use as processing aids in resins and rubbers. Individual sections of the bulletin cover the resin properties and their use in vinyl and polyethylene plastics, natural and synthetic rubbers, and adhesives.

Methods Employed in Compounding

Research—III¹

Ingredients for Compounding Research

I. Drogin²

THE following installment continues the section on ingredients for compounding research, which was begun in our December, 1952, issue. Part I of this series appeared in our October, 1952, issue.

Butadiene-Styrene Copolymers

Of the commercially synthesized rubber, butadiene-styrene copolymers (GR-S and Polysars) number many grades polymerized at as high a temperature as 122° F. and as low as 41° F., with different butadiene and styrene ratios, and having different Mooney viscosities for the final polymers. Some have been emulsified with rosin and/or fatty acid soaps, stabilized with various antioxidants, of which some are non-staining and non-discoloring. Some have been coagulated with alum, or salt and/or glue acid. Some have also been cross-linked with a fraction of a per cent. of divinyl benzene as a third monomer to give better calendering and extrusion. Some have a very low content of electrolyte and ash and a low water absorption. Some, low- or high-temperature polymerized copolymers, are masterbatched with various types of carbon blacks; some have been enriched with various oils at different loadings, and some with oil and carbon black as well. Some are smooth processing, and some have been strained and milled after drying, and some have improved tack. Each type has special features and specific applications in the manufacture of tires, mechanical goods, wire, cable, footwear, etc. In addition, there are many types of modified butadiene-styrene copolymer latices.

In view of the substantial increase in the past few years of commercially synthesized rubbers—butadiene-styrene copolymers and their modifications, manufactured and distributed—RFC, following the recommendations of the Rubber Industry Advisory Committee, recently established in a series of communications (63)³ a new system of numbering the GR-S polymers, the code of which is as follows:

GR-S Polymers	Series	
	Hot	Cold
Non-pigmented	1000	1500
Pigmented	1100	1600
Oil*	1200	1700
Oil black*	1300	1800
Latex	2000	2100
X-numbers	X	X

*As of July 25, 1952, series for these have been cancelled until January 1, 1953, and the polymers will be manufactured under their respective X numbers (See Table 5). On January 1, 1953, all X numbers which have the same base polymer and equal quantities of equivalent processing oils will be consolidated into a single permanent GR-S number which will incorporate the equivalent oils on an interchangeable basis.

The action became effective July 1, 1952.
As a guide to compounders in selecting the polymers

that have become available after this date, the following principles have been applied:

1. All hot rubber (122° F. GR-S), and including the cold rubber polymers (41° F. GR-S) 1503 and X-682, will be produced with a bound styrene content of 23½%. All cold rubber, with the exception of polymers 1503 and X-682, will contain 20% bound styrene.
2. Potassium persulfate will be continued to be used as the catalyst, and hydroquinone as the shortstop in the production of hot rubber.
3. Carbamate will be the shortstop in the production of cold rubber.
4. All cold rubber, with the exception of the 100% fatty acid emulsified types, will be polymerized in a standard sugar-free, iron activated recipe.
5. In general, three types of polymers will be made—staining, non-staining, and slightly staining.
6. In emulsifying cold rubber, there will be three types of emulsification: 100% rosin acid, 50/50 rosin/fatty acid, and 100% fatty acid.
7. The standard loading for carbon black masterbatches will be 50 parts of black on 100 parts of polymer.
8. The oil contents of the various polymers have been standardized at 25, 37½, or 50 parts oil on 100 parts of base polymer.
9. The rubber industry has until January 1, 1953, to evaluate various processing oils now being considered for the production of oil-rubber masterbatches. On January 1, 1953, all X numbers which have the same base polymer and equal quantities of equivalent processing oils will be consolidated into a single permanent GR-S number which will incorporate equivalent oils on an interchangeable basis.
10. Identification will be made of the brand of HAF carbon black, non-staining antioxidants, and processing oils incorporated in the polymers. These identifications will be by a letter following the GR-S code number. Letters have been assigned to the non-staining stabilizers, carbon blacks, and processing oils.

There is a detailed listing in Table 5 of the GR-S polymers available after July 1, 1952.

In addition to the above there are a number of butadiene-styrene type of polymers, under the brand name of Polysar, manufactured by the Polymer Corp. (64). As shown in Table 5, there are available 10 Polysar (dry) polymers and three latices.

On November 11, 1952, RFC Administrator Harry A.

¹ Based on a paper presented before the Ontario Rubber Section, C.I.C., Toronto, Ont., Canada, Mar. 11, 1952; The Los Angeles Rubber Group Inc., Los Angeles, Calif., Apr. 1; and the Northern California Rubber Group, San Francisco, Calif., Apr. 10.

² Director of research, United Carbon Co., Charleston, W. Va.

³ Numbers in parentheses refer to Bibliography items at the end of this installment. For references (1-35) see our Oct., 1952, issue, p. 69; (36-62), Dec. 1952, p. 369.

TABLE 5. IDENTIFICATION OF BUTADIENE-STYRENE (GR-S) SYNTHETIC RUBBERS

I. Synthetic Rubber Division, RFC*

A—Hot Non-Pigmented GR-S

(1000 Series)

Polymer	Bound Styrene %	Emulsifier	Short Stop	Reaction Temp. °F.	Stabilizer	Coagulation	Mooney Mean Raw, ML-4	Polymers Replaced	Remarks
1000	23.5	Fatty acid	Hydroquinone	122	Staining	Salt-acid	48	X-671; X-630; GR-S; GR-S-20	
1001	23.5	Fatty acid	Hydroquinone	122	Slightly staining	Salt-acid	48	X-631; GR-S-50; X-694	
1002	23.5	Rosin acid	Hydroquinone	125	Staining	Salt-acid	54	X-650; X-641; X-655; GR-S-10	
1003	23.5	Rosin acid	Hydroquinone	125	Slightly staining	Salt-acid	54	GR-S-18; X-274	
1004	23.5	Fatty acid	Hydroquinone	122	Staining	Alum	50	GR-S AC; GR-S-20 AC; X-12	
1005	23.5	Rosin acid	Hydroquinone	125	Staining	Alum	60	GR-S-10 AC	
1006	23.5	Fatty acid	Carbamate	122	Wingstay-S or equivalent	Salt acid	50	GR-S-26; GR-S-25; GR-S-21	
1007	23.5	Fatty acid	Hydroquinone	122	Staining	Glue-acid	50	GR-S-65	
1008	23.5	Fatty acid	Hydroquinone	125	Staining	Salt-acid	†125	GR-S-60	Cross-linked with divinyl benzene
1009	23.5	Fatty acid	Hydroquinone	125	Polygard or equivalent	Salt-acid	†125	X-704; GR-S-62; X-640; X-675	Cross-linked with divinyl benzene
1010	23.5	Fatty acid	Hydroquinone	122	Polygard or equivalent	Alum	30	X-685; X-644; GR-S-30 AC	
1011	23.5	Rosin acid	Carbamate	125	Polygard or equivalent	Salt-acid	54	X-645	
1012	23.5	Fatty acid	Hydroquinone	122	Wingstay-S or equivalent	Salt-acid	105	GR-S-86; GR-S-86 SP; X-567	
1013	43	Fatty acid	Hydroquinone	122	Polygard or equivalent	Alum	45	GR-S-40 AC	
1014	46	Rosin acid	None	150	Slightly staining	Salt-acid	65	X-491	Receives special finishing
1015	3	Rosin acid	Hydroquinone	125	Staining	Salt-acid	55	X-489	
1016	23.5	Fatty acid	Hydroquinone	122	Staining	Glue-acid	50	GR-S-65 SP	
1017	23.5	Fatty acid	Hydroquinone	125	Staining	Glue-acid	†125	GR-S-60 SP	Cross-linked with divinyl benzene
1018	23.5	Fatty acid	Hydroquinone	125	Polygard or equivalent	Glue-acid	†125	GR-S-61 SP; X-702	Receives special finishing
1019	23.5	Fatty acid	Hydroquinone	122	Polygard or equivalent	Glue-acid	50	GR-S-66 SP; X-703	
1020	23.5	Fatty acid	Hydroquinone	125	Polygard or equivalent	Glue-acid	†70	X-549 SP	
1021	46	Fatty acid	Hydroquinone	125	Staining	Acid-alum	90	X-278 SP	Receives special finishing
1022	23.5	Rosin acid	Hydroquinone	125	Polygard or equivalent	Glue-acid	80	X-674 SP; X-496 SP	Receives special finishing
1023	13	Fatty acid	Hydroquinone	122	Staining	Glue-acid	50	X-627 SP	Receives special finishing

N.B. Catalyst—persulfate in this series.

B—Hot Pigmented GR-S
(1100 Series)

Polymer	Carbon Black	Stabilizer	Polymers Replaced
1100	50 Parts EPC	Staining	Black I; Black III; Black IV
1101	50 Parts HMF	Staining	X-360
1102	60 Parts SRP (Pelletex)	Slightly staining	X-433
1103	50 Parts Phil-back A	Staining	X-579
1104	50 Parts Phil-back A	Slightly staining	X-419

N.B. In this series: 23.5% bound styrene polymer—100 parts; catalyst—persulfate; emulsifier—fatty acid; short stop—hydroquinone; reaction temperature—122° F.; conversion—72%. Mooney Polymer ML-4—37.

D—Cold Pigmented GR-S
(1600 Series)

Polymer	Emulsifier	Mooney Polymer, ML-4	Polymers Replaced
1600	Rosin acid	50	X-580; X-581; X-582
1601	50/50 rosin fatty acid	36	X-598; X-607; X-608; X-656

N.B. In this series, a sugar-free recipe: carbon black, 50 parts HAF; 20% bound styrene polymer, 100 parts; activator—iron; short stop—carbamate; reaction temperature—41° F.; stabilizer—staining.

C—Cold Non-Pigmented GR-S
(1500 Series)

Polymer	Bound Styrene %	Activator	Emulsifier	Reaction Temp. °F.	Stabilizer	Coagulation	Mooney Mean Raw, ML-4	Polymers Replaced	Remarks
1500	20	Iron	Rosin acid	41	Staining	Salt-acid	52	GR-S-100; GR-S-101; X-647; X-670	
1501	20	Iron	Rosin acid	41	Slightly staining	Salt-acid	52	X-637	
1502	20	Iron	50/50 Rosin fatty acid	41	Wingstay-S or equivalent	Salt-acid	52	X-625	
1503	23.5	Peroxamine	Fatty acid	41	Polygard or equivalent	Glue-acid	55	X-620 SP; X-565 SP	Receives special finishing
1504	12	Peroxamine	Fatty acid	41	Polygard or equivalent	Glue-acid	52	X-697 SP; X-601 SP	Receives special finishing
1505	8	Iron	Rosin acid	41	Staining	Salt-acid	40	X-600	

N.B. Iron activated polymers in sugar-free recipe. Carbamate short stop used for all polymers in this series.

E—Oil Masterbatch GR-S

Polymer	Brand	Oil Parts	Activator	Emulsifier	Stabilizer	Mooney Polymer, ML-4
X-628	Circosol 2XH	25	Iron	50/50 rosin fatty acid	Staining	50-70 for m.b.
X-654	Shell SPX-97	25	Iron	50/50 rosin fatty acid	Staining	50-70 for m.b.
X-712	Sundex 53	25	Iron	50/50 rosin fatty acid	Staining	50-70 for m.b.
X-713	Sundex 53	25	Iron	Rosin	Staining	50-70 for m.b.
X-714	Shell SPX-97	25	Iron	Rosin	Staining	50-70 for m.b.
X-700	Dutrex 20	25	Iron	50/50 rosin fatty acid	Staining	50-70 for m.b.
X-715	Califlux TT	25	Iron	50/50 rosin fatty acid	Staining	50-70 for m.b.
X-716	Sundex 53	37.5	Iron	50/50 rosin fatty acid	Staining	45-65 for m.b.
X-717	Circosol 2XH	37.5	Iron	Rosin acid	Staining	45-65 for m.b.
X-706	Shell SPX-97	37.5	Iron	50/50 rosin fatty acid	Wingstay-S or equivalent	45-65 for m.b.
X-693‡	Circosol 2XH	25	Iron	50/50 rosin fatty acid	Polygard or equivalent	50-70 for m.b.
X-718	Circosol 2XH	37.5	Peroxamine	Fatty acid	Wingstay-S	45-65 for m.b.
X-709	Circosol 2XH	50	Iron	50/50 rosin fatty acid	Wingstay-S	55-75 for m.b.

N.B. In this series, a sugar-free recipe (except for X-718): short stop—carbamate; reaction temperature—41° F.; all contain 100 parts 20% bound styrene, high Mooney viscosity polymer except X-718, where bound styrene is 23.5%.

* Synthetic Rubber Division, Reconstruction Finance Corp., 811 Vermont Ave., N. W., Washington 25, D. C.

† Compound Mooney-value after compounding in RFC test formula.

‡ Glue-acid coagulated.

Polymer	Black Parts	Oil-Brand	Parts	F—Oil-Black Masterbatch GR-S						Reaction Temp., °F.	Mooney Polymer, ML-4
				20% Bound Styrene Polymer	Sugar Free	Activator Iron	Emulsifier 50/50 Rosin/Fatty Acid	Short Stop Carbamate	Stabilizer		
X-629	HAF 50	Circosol 2XII	25	100						41	55-75 for m.b.

G—Hot Latex GR-S
(2000 Series)

Polymer	Bound Styrene %	Reaction Temp., °F.	Mooney Polymer, ML-4	Solids %	Polymers Replaced	Remarks
2000	40	150	75	39.1-42	Types III and IV	
2001	46	150	33	37-39	X-381	
2002	46	140	65	47-49.9	X-446	
2003	30	150	73	59 min.	Type V	Fatty acid stabilized
2004	Polybutadiene latex	150		55 min.	X-653	Fatty acid stabilized
2005	43	150	55	60-63	Type VI	
X-695	23.5	122	50	26-28	Type II; X-523	Hydroquinone short stopped. 40 ppm on latex added formalin

N.B. Rosin acid emulsifier except X-695 which uses fatty acid.

H—Cold Latex GR-S
(2100 Series)

Polymer	Polymer Bound Styrene %	Emulsifier	Activator	Reaction Temp., °F.	Conversion %	Mooney Polymer	Solids %
2100*	23	65/35 rosin/fatty acid	Iron**	50	60	85 ML-4	47-49.9
X-617	23	Fatty acid	Peroxamine	41	60	85 MS-4	23-25 (pH 10-11)
X-619	23	65/35 rosin/fatty acid	Iron**	50	60	160 ML-4	60 min.
X-633	46	Fatty acid	Peroxamine	50	80	85 ML-4	49 max.
X-667	14	Fatty acid	Peroxamine	40-50	60	75 MS-4	60 min.
X-678	25	Fatty acid	Peroxamine	50	83	163 ML-4	58-62
X-683	25	65/35 rosin/fatty acid	Peroxamine	50	60	140 ML-4 min.	47-49.9
X-684	25	65/35 rosin/fatty acid	Peroxamine	50	60	140 ML-4 min.	60-63
X-701	23	Fatty acid	Peroxamine	41	80	85 MS-4	35 min. (pH 10-11)

N.B. Short stop—carbamate in this series.

** Sugar-free recipe, 2100 stabilized with fatty acid.

II. POLYMER CORP.††

A—Identification of Polysar S Butadiene-Styrene Rubbers

Polymer Code	RFC Equivalent	Mooney Viscosity ML-4	Stabilizer	Uses	Remarks
Polysar S	GR-S 1000	46-54	Staining and discoloring	Tires; footwear; battery boxes; hose; belting; mechanical goods. Only in black stocks out of contact with light-colored material	Standard general-purpose butadiene-styrene rubber
Polysar S-20	GR-S 1000	41-49	.....	.....	Similar to Polysar S. Requires less breakdown
Polysar S-50	GR-S 1001	46-54	Relatively non-staining and non-discoloring	Light-colored mechanical goods; floor tile; and nuclear-type shoe soles	Similar to Polysar S
Polysar S-25	GR-S 1006	46-54	Non-staining and non-discoloring	White or very light-colored mechanical goods; footwear; and floor tile	Similar to Polysar S
Polysar S-65	GR-S 1007	46-54	.....	Wire and cable	Similar to Polysar S except that it contains very little water soluble ash
Polysar S-X-371	GR-S 1009	.....	Same as in Polysar S-50	Can replace other Polysar S types up to 50% where low shrinkage is desired and lower physical properties can be tolerated	A terpolymer of butadiene-styrene and divinyl benzene

B—Identification of Polysar Butadiene-Styrene Special Rubbers

Polymer Code	Mooney Viscosity, ML-4	Stabilizer	Uses	Remarks
Polysar Krylene	49-61	The same as in Polysar S	Tire treads; belt covers; or wherever a long-wearing stock is needed	A butadiene-styrene copolymer produced by the cold rubber system
Polysar Krymol	....	The same as in Polysar S	In place of Polysar S or Krylene in tire treads, footwear, and mechanical goods	A special butadiene-styrene copolymer, high-grade process oil enriched polymer
Polysar Krymol NS	....	The same as in Polysar S-50	Light-colored mechanical goods and soles	Same as Polysar Krymol except that it contains a light-colored oil
Polysar SS-250	....	The same as in Polysar S-50	Where increased hardness without increased specific gravity is desired; i.e., in nuclear shoe soles, rubber floor tile, and luggage material	A copolymer of butadiene and styrene with a higher combined styrene content than Polysar S

C—Identification of Polysar S Latices

Polymer Code	Total Solids %	Residual Styrene	pH	Soap (Wet Wt.) ‡‡	Mooney Viscosity §§	Combined Styrene in Copolymer %	Surface Tension (Dynes/Cm)	Uses	Remarks
Polysar S Latex Type II	26.0-28.0	0.50 max.	9.2-10.0	1.8	46-54	††24	.....	Coatings; tire cord dipping	Rubber portion is a copolymer of butadiene and styrene in the ratio of approximately 76 to 24. It is emulsified with a fatty acid soap and contains no antioxidant other than the small amount used to stop the reaction; free of foreign or extraneous material

ney Polymer, ML-4
0 for m.b.
5 for m.b.
5 for m.b.
5 for m.b.
0 for m.b.
5 for m.b.
5 for m.b.
1 styrene,

Latex Type IV

Adhesives; tire cord dipping; textiles, for anchoring the tufts or pile in a pile fabric, and to reinforce the base construction in rugs and carpets; with synthetic resin emulsions to bind asbestos fibers in the manufacture of high-quality gaskets and sheet material; leather regeneration

Rubber portion is a copolymer of butadiene and styrene reacted in the ratio of 1:1. It is emulsified with a rosin acid soap and contains no antioxidant or staining material; free of foreign or extraneous material

(Continued on next page)

TABLE 5. II-C (Continued)

Polymer Code	Total Solids %	Residual Styrene	pH	% Soap (Wet Wt.) ^{††}	Mooney Vis- cosity ^{‡‡}	Combined Styrene in Copolymer %	Surface Tension (Dynes/Cm)	Uses	Remarks
Polysar S Latex Type X-381	37.0-39.0	0.50 max.	10.0-11.0	3.0	25-40	...	45.0 min.	Paper and leather saturation and paper coating	Rubber portion is a copolymer of butadiene and styrene reacted in the ratio of 1:1. Mooney viscosity is lower than that of Type IV. Emulsified with a rosin acid soap and contains no antioxidant or staining material; free of foreign or extraneous material.

N.B. Particle size (Angstroms)—ca. 1000 (typical analysis) in this series.

[§] MS-4 is Mooney viscosity measured with a small rotor; and ML-4, with a large rotor. ML-4 values are approximately 1.8 x MS-4 values.

[†] Replaces X-347.

^{††} Polymer Corp., Ltd., Sarnia, Ont., Canada.

^{‡‡} Typical analysis.

^{§§} ML-4[‡], 212° F.

McDonald, stated that for the last quarter of 1952 and the first quarter of 1953, a six-month period, the manufacturers of rubber products forecast that they will require 315,517 long tons of GR-S rubber, of which 173,682 tons will be LTP GR-S and 141,835 tons 122° F. GR-S. In addition, a requirement of 34,000 tons of butyl rubber was estimated.

Of the GR-S requirements, the 55% estimate for LTP GR-S is an increase over the consumption pattern of recent months, when use of cold and hot rubber was about evenly divided.

Detailed figures from the consuming industry also showed a substantial trend toward oil-masterbatched GR-S. While the recent average monthly use of this type of GR-S has been about 4,500 long tons, estimates for November, 1952, were about double the previous average figure.

GR-S Type Latices

GR-S latices are basically copolymers of butadiene and styrene made by an emulsion technique. Prior to July 1, 1952, GR-S latices were identified by standard types (I-VIII). There were also numerous experimental types designated by X numbers which only became classified as a standard type when their volume of usage was sustained on a substantial basis. The standard types gradually increased to eight in number as wider fields of applications in latex processes developed, which called for latices of improved properties.

Methods of preparation of each standard type vary in one or more respects governed by the butadiene-styrene ratio, emulsifier, polymerization temperature, shortstop or antioxidant, % monomer conversion, solids content, Mooney viscosity of contained polymer, stability, behavior to concentration by creaming or evaporation, properties of films, color, rate of drying, tack, water resistance, cure rate, performance at elevated temperatures, and flexibility at sub-freezing temperatures.

The eight standard types, as pointed out by Howland, Neklutin, Brown, and Werner (65), may be characterized as follows: Types I and II have a solids content of 26 to 28%; while Type III is made to 37 to 39% solids. Type II is the same as Type I except that no antioxidant has been added; therefore Type II films are light in color. Type III is made by charging approximately equal parts of butadiene and styrene into the reactor and using a rosin acid soap as an emulsifier. No antioxidant is added. Type IV is similar to Type III except it is prepared to 39.1 to 42% solids. Type V latex is polymerized to 59% minimum solids with low

emulsifier content to give large particle size, approximately 3000 Å diameter, and relatively low viscosity, 250 centipoise (cp) maximum at 55% solids. It was developed primarily for production of foamed sponge, but has also been used in other applications requiring high solids latex.

Type VI latex is currently manufactured by a production formula designed for slow reaction in order to obtain larger particle size and thus lower the Mooney viscosity. The latex is now made at a 55-45 butadiene-styrene ratio to 60 to 63% solids using 60 parts of charge water to 100 of monomers, with Dresinate 731 and Daxad 11 for emulsification. Additional Dresinate 731 is added in a booster mixture at 45 to 48% solids in order to carry the polymerization to as near 100% conversion as possible and to increase stability of the latex. The polymerization is started at 140° F. and finished at 150° F. Since the conversion never actually proceeds much over 95%, the unreacted monomers are removed by steam distillation. No shortstop or antioxidant is added to the latex.

Type VII latex formula is somewhat similar to that for Type VI. One of the major differences is the use of an 80-20 butadiene-styrene ratio in order to give a copolymer with good flexibility at sub-freezing temperatures, and another difference is the use of fatty acid soap instead of Dresinate soap in the booster and stabilizing solution, which is added to the polymerization system at 40 to 45% solids. Final solids are 60 to 63%. Type VIII latex is quite similar to Type VI except that it is made to 50 to 55% solids. The properties of several standard and experimental GR-S latex types are summarized in "Compounding Ingredients for Rubber" (66). Types and specifications under which GR-S latices were sold by the Office of Rubber Reserve, RFC, are described by Vila (55).

As of July 1, 1952, the Synthetic Rubber Division, Reconstruction Finance Corp., has revised (63) its identification of GR-S synthetic rubbers and in the case of GR-S latices has standardized on the manufacture of 16 GR-S latices grouped under two series, as shown under I, G and H, in Table 5. Hot latex GR-S is in series 2000 and cold latex GR-S in series 2100. In addition to the GR-S latices from RFC there are available three Polysar latices from Polysar Corp. These are listed under II, C, in Table 5.

In the revision by RFC, X-695 replaces Type II, and it also contains 40 ppm (on the latex) of formalin in order to prevent bacterial action in storage of the latex; GR-S 2000 replaces Types III and IV; GR-S 2003 replaces Type V, and GR-S 2005 replaces Type VI. GR-S

2004, a polybutadiene latex, is for use mainly in foam sponge manufacture as a blend with natural rubber latex. Its main advantage over GR-S 2003 lies in the lower odor of the finished sponge.

The cold latex GR-S polymers X-619, X-667, X-678, X-683, and X-684, as pointed out by Howland and Neklutin (67), are produced primarily for use in foam sponge manufacture, either as blends with natural rubber latex or on a 100% synthetic basis. All of these latices containing polymers of high Mooney viscosity are concentrated to about 60% total solids content. The one exception, X-683, is sold at 47 to 49.9% total solids content. The above latices differ from one another mainly in monomer ratio and emulsifier systems used. X-619 latex, having a high Mooney viscosity (150 to 170) contained polymer is heat concentrated from about 48.5% to 60 to 63% solids. X-617 and X-701 are cold rubber GR-S latices made to around 23 and 35% total solids content, respectively, primarily for use in tire cord dipping, and these also contain polymers of high Mooney viscosity. GR-S 2100 is a general-purpose latex used in many applications. X-633 is the only cold rubber latex at the present having a high styrene content (46%). It is sold at 47 to 49% total solids content and contains a polymer with a Mooney viscosity of 70-100 (ML-4).

The stable pH range of GR-S latices, according to Zwicker (68), is from 8.5 to 12.0. The particle diameters of synthetic latices can be varied over a wide range, size, and distribution. GR-S commercial latices range in particle diameter from 0.05- to 0.22-micron. *Hevea* latex particles vary in size from 0.5- or less to 3.0 microns, with a very large number of particles being less than 0.5-micron in diameter. On the average, however, the particle size of synthetic polymer latices is much smaller than that of *Hevea* latex. This fact requires the compounding to set up a new yardstick for stabilizing synthetic latices for commercial use. As pointed out by Gillman, Thoman, and Chalmers (69), the difference in particle size of GR-S latex, as compared with natural latex, may explain, at least in part: better dilution stability, higher viscosity and greater increase in viscosity upon the addition of thickeners.

Although cold GR-S latex was first produced commercially in June, 1949, interest was comparatively dormant until the shortage of *Hevea* latex became acute, and prices began to skyrocket. During 1950 the industry learned to use cold GR-S latex as a 100% replacement for *Hevea* in many uses in foam sponge, dipping tire cord treatment, and various watering and saturation applications. According to Vila (70), the progress made in the polymerization and utilization of cold GR-S latex is perhaps the most significant development of 1951 on the technical front.

Smith, Werner, Westerhoff, and Howland (71) point out that preeminent among the superiorities of GR-S latices polymerized at low temperatures is the improved tensile *versus* low-temperature stiffening relationship. Wet strength of the coagulum (important in mold-cure products) is also notably enhanced. An additional improvement is the almost complete absence of odor in cold latex from which the unreactive monomers have been carefully stripped. Articles produced from cold latex indicate that for the first time substantially odorless GR-S latex products can now be manufactured.

There are certain very definite advantages in GR-S latices, and one of the most important is, as stated in the report on Gen "al-Purpose latices (72), the absence of protein stabilizers, which makes these latices relatively free from putrefaction and the accompanying objectionable odors. The odor of GR-S latices is currently aromatic because of a very slight amount of residual uncombined styrene monomer. The freedom from ammonia

offers a decided advantage in favor of the GR-S latices since ammonia is not only objectionable to many people, but it has a distinct allergic effect on others.

Butadiene-styrene copolymers are, according to Howland, Peaker, and Holmberg (72), slower curing than natural rubber. More acceleration and the higher sulphur content found generally desirable for curing the bulk rubber are required with the latices. Fillers, particularly carbon blacks, in GR-S latices have the unusual effect of producing reinforcement in contrast to their effect in natural rubber latex where they act only as diluents. Drying temperatures must be very low with synthetic latex films because of the low strength of the wet film. Synthetic latices mix readily with natural latex, and the properties of the resultant films are generally intermediate, depending on the proportions used.

Zwicker (68) points out that it is an axiom in rubber technology that a vulcanized natural rubber latex film represents the peak of ultimate tensile strength of a high elastic material. It is true that its 50,000 to 60,000 pounds per square inch tensile strength at break (based on actual cross-sectional area at the 900 to 1100% elongation) is exceeded by few elastic organic compounds with the exception of fibers. So far, synthetic flexible polymers commercially available in latex form fall far short of *Hevea* in this ultimate property. Rubbers of low styrene butadiene ratio are, according to Zwicker, intermediate between *Hevea* and nitrile rubbers in tack, modulus, and oxidation resistance, but inferior to both in gum tensile strength. Residual odor is difficult to remove, and there is little inherent adhesion to hydrophilic surfaces.

Because of their inferior gum tensile properties, the low styrene latices have been used since World War II, principally in non-tacky tire cord adhesives and as diluents in *Hevea* foam.

The butadiene-styrene rubbers of intermediate styrene content are less rubbery and more thermoplastic and form tougher unvulcanized and vulcanized films. They are less susceptible to oxidative degradation, and adhesive properties are better. Until now, the intermediate styrene rubber latices were preferred to the low styrene rubbers for natural rubber latex extenders in spite of relatively poor low-temperature flexibility and higher modulus. With the advent of the new cold rubber latices this trend may be reversed.

All synthetic latices, according to Gillman *et al.* (69), have excellent stability to mechanical disturbances; natural latex may be rated good in this respect. GR-S latices also have excellent dilution stability. Care must be exercised in adding vulcanizing agents to GR-S latices as they are unstable chemically. Natural rubber latex is somewhat better in this respect.

Creaming, according to Smith *et al.* (71), has become well established as a means of concentrating certain low solids GR-S latices, noticeably Types II and IV, for special applications. A fundamental difference exists between creaming of Types II and IV latices and creaming X-547 (now replaced by GR-S 2100), since the former have average particle size in the range of 600 to 1200 Å; while the X-547 average is 2000 to 2500 Å. In creaming X-547 from solids to 60% solids it was found that only 20-25% as much of the creaming agent combination was required as in creaming Type II and Type IV latices. Clear serums, furthermore, are obtained in creaming X-547; whereas loss of polymer in the serum from Type II and Type IV adds to the costs of creaming the latter types.

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Addenda

The following information on rosin extended GR-S was submitted as we were going to press.

A recent development in connection with the copolymerization of butadiene and styrene is the extension of these polymers with rosin and rosin derivatives, such as Dresinate 731, in place of petroleum oils. Laboratory work on these rosin extended rubbers has been done by Naugatuck Chemical Division, United States Rubber Co.; Copolymer Corp.; and Hercules Powder Co. Pilot-plant runs have been made by Naugatuck Chemical and Copolymer Corp.

Approximately 60,000 pounds (J-5158), masterbatched with HAF carbon black, were prepared at Phillips Chemical Co. plant in Borger, Tex., for evaluation in tire treads by U. S. Rubber and on the Government Tire Test Fleet (Project DA). About 2,000 pounds (J-5157), masterbatched with SRF black, for evaluation in carcass stock (Project DA), and a similar amount (J-5847-A), masterbatched with SAF black, for evaluation in tire treads, were prepared by Naugatuck Chemical. Five thousand pounds (PF-208-694) were made by Copolymer Corp. for dry compounding by Mansfield Tire & Rubber Co. with HAF and SAF blacks for evaluation on the Government Tire Test Fleet (Project DB), and for dry compounding by Armstrong Tire & Rubber Co. in carcass stock for evaluation on the Government Tire Test Fleet (Project DC).

The rosin used to extend the GR-S, according to Howland, Reynolds, and Provost (73) is equivalent to the petroleum oils in extending efficiency, but considerably superior in many other respects. This rubber gives as much as 20-40% better resistance to abrasion, up to 30% higher tensile strength, 10 to 15 degrees less temperature rise on flexing, five- to 10-fold increase in flex crack resistance, and superior aging resistance. J. P. McKenzie, Copolymer Corp., claims that rosin extended rubber dries infinitely better than oil extended rubber and also has much better aging properties.

(To be continued)

Plasticizers for Elastomers

(Continued from page 502)

ing blends of plasticizers which by themselves will form eutectic mixtures. By blending plasticizers of high freezing points with other plasticizers in suitable proportions to form eutectic mixtures of much lower freezing points, these mixtures can then be used advantageously much

as one would a single plasticizer. As a guide to the selection of such plasticizer blends, it would seem that the opportunities for large freezing point depressions would be greatest when compounds of dissimilar structure and with different attractive groupings are mixed. No limit exists, moreover, on the number of plasticizers which can be blended in this way.

This approach has received only minor formal attention, although there is hardly a laboratory concerned with low-temperature formulation which hasn't found some particular blend of plasticizers to give outstanding results. As a matter of fact, most commercial compounds appear to contain blends of plasticizers rather than individual ones. I believe this field is a very fruitful one which offers great opportunities for producing compounds usable at lower and lower temperatures, by suitable blending of currently available plasticizers.

Table 4 shows a list of the major low-temperature plasticizers used in the trade in commercial elastomers. This is by no means a complete list of all low-temperature plasticizers, and it will undoubtedly be constantly changing, particularly as the newer plasticizers develop more of a history and as the use of blends increases.

TABLE 4. MAJOR LOW-TEMPERATURE PLASTICIZERS USED IN THE TRADE

Vinyl Chloride Resins
Diethyl Sebacate
■ Adipate
■ Azelate
■ Harflex 500
■ Triocetyl Phosphate
■ Glycol Octoates
■ Tetrahydrofurfuryl Oleate
Vinyl[Butyral Resins
■ Diethyl Sebacate
■ Cellosolve Adipate
■ Triglycerol Dihexoate
Butadiene-Acrylonitrile Rubbers
■ Diethyl Sebacate
■ Plasticizer SC
■ Tributoxyethyl Phosphate
■ Polyglycol Dioctoate
■ TP-90B
Neoprene
■ Diethyl Sebacate
■ Di-isobutyl Adipate
■ Plasticizer SC

Summary

The physical basis for plasticizer action in elastomers has been discussed, showing the importance of association forces and the details of the chemical structure of plasticizers.

Criteria for the selection of plasticizers for commercial compounding are divided into two categories, necessary and desirable. The importance of realistic test procedures related as closely as possible to actual service conditions is stressed.

Particular attention has been devoted to the phenomenon of low-temperature performance of plasticizers. This has been shown to be strongly influenced by three characteristics of the plasticizer: namely, compatibility, viscosity, and viscosity index. A study of the relation between freezing point of the plasticizer and freezing point of the plasticized elastomer showed that there was no direct primary relation between the two, and in many cases the occurrence of association complexes and eutectic mixtures must be considered. It was suggested that this principle can be used to advantage in the production of extreme low-temperature compounds by the use of properly selected blends of plasticizers.

"Specify Class H Electrical Insulation Made with Dow Corning Silicones." Dow Corning Corp., Midland, Mich. 8 pages. Class H silicone-type electrical insulating materials are described in this bulletin, together with reports on performance received from the field.

Further Extracts from Paley Commission Report on Coal and Petroleum Chemicals and Products Made Therefrom—IV¹

THE following installment concludes Chapter 13, a condensation of a study made for the Commission by Gustav Egloff on natural gas and petroleum as industrial raw materials, which was begun in our October and continued in our November issues.

Summary

Tables 13-17 include requirements for chemical conversion of all basic materials that can be derived from petroleum or natural gas by recovery or refining processes. With only a few exceptions, which have been specified, these requirements are the quantities of basic materials which would be necessary to satisfy demands for all end-products which can be derived therefrom. Inasmuch as some demands will be fulfilled from other sources, actual requirements for a number of the basic materials will be lower than those estimated herein.

These estimates are subject to a number of limitations which must be carefully considered. Some small, but nevertheless highly important requirements have been excluded. Even though availability of hydrocarbons is greatly in excess of demands, these small requirements present the important problem of additional plant construction. For example, isoprene, which comprises 2% of the butyl rubber requirements, has been omitted inasmuch as total quantities of raw materials are insignificant compared to the whole.

At the same time, greater quantities of some of the large-volume raw materials than will actually be needed have been estimated. For example, benzene includes aromatic requirements for which mixtures or other compounds such as toluene and xylenes may be used. From a practical standpoint, these differences are important because in some cases purification units and plants for producing individual compounds will not be necessary. Possible requirements of alternative materials which are a different type of compound, such as butadiene and acetylene to replace benzene for nylon, have also been omitted.

Another example of basing requirements on a type compound is the estimation of phthalate plasticizers on the basis of di-iso-octyl phthalate which utilizes iso-octyl alcohol from heptenes. At present di-2-ethylhexyl phthalate, prepared from 2-ethylhexyl alcohol from synthesis gas, is the derivative in highest production. Large volumes of diethyl and dibutyl phthalates are also produced, but the di-iso-octyl compound seems to have greatest promise for the future; hence requirements have been estimated on that basis.

In basing requirements on end-products such as plastics, textiles, etc., many of the smaller-volume chemicals have been omitted. For example, maleic anhydride was not included in calculations of basic materials for alkyds. Estimates for alkyls were made entirely on the basis of 100% use of phthalic anhydride. Total maleic anhydride requirements for all purposes, however, have been included in the final estimate of benzene by projecting present consumption of benzene in maleic anhydride. This type of estimate involves some pyramiding of figures, e.g., in this instance, some *o*-xylene would be alternative with benzene. The total estimates, however, are relatively free from this type of error.

The numerical calculation of estimates is only very rough at best. With few exceptions, quantities had to be calculated arbitrarily on the basis of 90% of theoretical yields per each chemical conversion. Actual percentage yields were used in those few cases for which they were available. Furthermore these calculations have been based on the principal product and have not taken the by-products into account. As a hypothetical example, a quantity of hydrocarbon A would be calculated on the basis of a known 80% yield of compound B. However, the entire requirements of hydrocarbon A for compounds C and D, which are produced both simultaneously as a by-product of B and as major products of other processes, would be calculated on the basis of the processes which do not produce B. Thus there would

¹ The President's Materials Policy Commission Report of June 23, 1952. U. S. Government Printing Office, Washington, D. C.

TABLE 13. REQUIREMENTS FOR METHANE AND NATURAL GAS
(Millions of Pounds)

Year	A	B	Methane	C	D	E	Acetylene†	F	Ammonia†	Pentanes
1955.....	2,019	2,413	4,830	24,800		1,046	1,481		5,200 (2.6+10 ⁴ tons)	35
1960.....	3,104	3,806	5,968	23,850		1,848	2,629		6,400 (3.2+10 ⁴ tons)	50
1975.....	6,628	8,427	9,452	12,950		4,764	6,748		10,400 (5.2+10 ⁴ tons)	75

*Chemicals derived from propane or butane in natural gas, and hydrogen and carbon black derived from natural gas have been calculated as derivatives of methane.

†These are not additional requirements. Basic source material is included under methane.

A. Requirements for all chemicals except ammonia, carbon black, and that part of acetylene which may be used for chemicals derivable from ethylene.

B. Requirements for maximum usage of acetylene are included.

C. Requirements for ammonia only. These quantities are not entirely in addition to A or B. Some products in addition to hydrogen for ammonia can be produced from these quantities of methane.

D. Requirements for carbon black only.

E. Excludes acetylene requirements for chemicals which are also derivable from ethylene.

F. Includes acetylene requirements for chemicals which are also derivable from ethylene.

be some duplication in total estimated requirements of A.

The prediction of future requirements represents a summary of a number of factors. Known projected increases and predictions of other authors quoted herein were given primary consideration. Growth in population was always considered, and, finally, the estimates were revised in whatever direction seemed logical on the basis of quality and demand for known products. In some instances demand will either level off or accelerate to a greater extent than was assumed in these estimates. However, production of the estimated quantities of raw materials will in all probability be necessary. It is assumed that research will be carried on at a high tempo to develop new products which will be based on these same raw materials. The new products and resulting new demands from this research will also equalize any lower material requirements which may be brought about by increased efficiency of processes.

This summary does not give quantities of derivative products which will be required. Some insight into the amounts of specific chemical derivatives can be found under the more detailed discussions of individual basic materials (methane, ethylene, benzene, etc.) and end-products (textiles, rubber, detergents, etc.). For example, the major portion of hydrogen cyanide requirements are given under textiles; while its raw material requirements have been given in quantities of methane in the final summary.

Gas-Based Materials

Table 13 includes estimates of basic materials derived from natural gas. Although large quantities of propane and butane are present in natural gas, they are used for much the same purposes as methane, which is the major constituent. Since they are present in small percentages compared to methane, all requirements have been calculated on the basis of methane. Pentanes have been listed separately as they are used for different purposes. Total requirements of acetylene and ammonia, both of which are produced from either methane or total natural gas, have been listed also. These are not additional requirements. Acetylene is used for a number of purposes for which ethylene is an alternative basic material. The listing under column E excludes acetylene requirements for derivatives which can also be produced from ethylene, and column A gives the methane necessary for the quantity of acetylene in column E.

The methane requirements under C and D are principally additional to that under A or B. The quantities in column C, which gives requirements of methane for ammonia, would, however, supply some materials that could be used to replace quantities under A or B. For the purposes of simple comparison, B+C+D will be regarded as the maximum possible requirements of methane. Thus a maximum production of 32 billion pounds of methane in 1955, 33.6 billion in 1960, and 30.8 billion in 1975 would be sufficient. From a comparison with availability³ from natural gas of 110 billion pounds in 1955, 121.8 billion in 1960, and 217.5 billion in 1975, it is evident that the raw material position in relation to methane-derived products is secure.

Availability of pentanes has not been calculated since they are utilized largely in gasolines. However, more than adequate quantities are available for the comparatively small requirements for chemical conversion.

Materials from Cracking Processes

Table 14 includes estimates of basic olefin materials. Ethylene, propylene, and butylenes are derived as by-products from cracking of petroleum fractions and from

special processes in which ethane, propane, butanes or mixtures thereof are cracked. The higher olefins such as the heptenes are derived from liquid fractions obtained by the cracking of petroleum.

TABLE 14. REQUIREMENTS FOR OLEFINS
(Millions of Pounds)

Year	Ethylene		Propylene	Butylene		Higher Olefins (Heptenes Etc.)
	A	B		Normal	Iso-	
1955.....	3,550	2,550	1,561	1,940	242	100
1960.....	5,200	3,700	2,043	2,040	434	190
1975.....	10,400	7,000	3,563	4,700		380

A. Maximum requirements if ethylene were used as sole source material for its derivatives.

B. Excludes ethylene replaceable by acetylene and assumes 40% ethyl alcohol production from other sources.

Maximum requirements of ethylene are listed in column A. These requirements are based on calculations of the total needed to make all end-products which can be derived from ethylene. Many of these products are derived from other sources. In column B, allowance is made for those products which are also derived from acetylene and for ethyl alcohol which is assumed to be derived from other sources to the extent of 40%. Actual requirements will probably be greater than the quantities under B, but somewhat less than those under A. Assuming the maximum possible requirements given in column A, only 3.55 billion pounds would be required in 1955, compared to an availability of 24.3 billion pounds from cracked gases and the cracking of ethane. For 1960 a demand of 5.2 billion pounds is far less than availability of 26.9 billion pounds; and for 1975, a demand of 10.4 billion compares favorably with availability of 34 billion pounds. Actually much greater quantities of ethylene could be made available. The cracking of propane is one of the major sources, and availability of propane from cracked gases alone will be about 16 billion pounds in 1955 and 1960 and 12 billion in 1975.

Propylene requirements total 1.56 billion pounds in 1955 compared with availability of 28.6 billion pounds from cracked gases. Supplies continue to be more than adequate in 1960 when requirements are 2.04 billion pounds, against availability of 32.1 billion pounds, and in 1975 when requirements are 3.56 billion, and availability 42.5 billion pounds.

The availability of butylenes is also far greater than requirements. A total of 30.7 billion pounds will be available, as compared with requirements of 2.18 billion pounds in 1955, 36.2 billion, compared with requirements of 2.47 billion in 1960, and 52.8 billion, compared with requirements of 4.7 billion in 1975.

The availability of higher olefins from cracked petroleum fractions has not been estimated, but is known to be almost unlimited compared to requirements.

Aromatics from Hydrocarbons

Table 15 gives estimated requirements of benzene, toluene, and xylene for chemical conversion and for direct use as solvents. The naphthenes used for chemical conversion are consumed principally in the preparation of aromatics. Therefore estimates of requirements will not be made. The benzene requirements, particularly for 1960 and 1975, have included a number of uses for which toluene or xylenes, and in some cases, aromatic mixtures, can be used. Toluene requirements do not include the large tonnages necessary for TNT. The quantities of o-xylene have been estimated on the basis of all phthalic anhydride being derived therefrom. Ac-

³As used here and in subsequent discussions, availability signifies amounts of a material present in petroleum, natural gas, or refinery products. It does not necessarily mean that there is present or projected plant capacity for production or recovery.

tually the principal phthalic production comes from naphthalene and will continue to be so produced for a number of years. Estimates of *p*-xylene are entirely for synthetic fibers. It is highly probable that *m*-xylene will also be used for this purpose, and the 1975 estimate, at least, may be partially supplied by the meta isomer. The "other xylene" column includes some quantities of ethylbenzene, which is obtained in mixtures of eight-carbon atom aromatics along with the xylenes. As soon as proper purification and separation procedures have been worked out, ethylbenzene will supplant some of the benzene and ethylene required for styrene.

TABLE 15. REQUIREMENTS FOR AROMATIC HYDROCARBONS
(Millions of Pounds)

Year	Xylenes					Others, Including Mixtures
	Benzene	Toluene*	Ortho	Para	Others, Including Mixtures	
1955.....	2,881	495	272	27	400	
1960.....	3,630	635	349	114	550	
1975.....	6,651	1,060	686	756	900	

*Includes only solvents and chemicals exclusive of TNT.

Availability of aromatics from petroleum fractions is far in excess of requirements. Requirements of benzene are estimated at 2.88 billion pounds for 1955, compared with availability of 9.35 billion pounds, for 1960, 3.63 billion, compared with 11.76 available; and for 1975, 6.65 billion compared with 18.95 available. Toluene requirements are only 495 million pounds, in contrast to availability of 18.34 billion pounds in 1955; 635 million, in contrast to availability of 22.98 billion in 1960; and 1.06 billion in contrast to availability of 36.9 billion pounds in 1975. Even greater amounts of xylenes are available. In 1955, a total of 23.47 billion pounds could be produced from petroleum; while requirements should not exceed 700 million. In 1960, requirements will be about 1.01 billion, in contrast to 28.52 billion pounds available, and about 2.34 billion, in contrast to 42.26 billion pounds, in 1975.

Other Hydrocarbon Chemicals

Table 16 includes other basic chemical source materials from petroleum and natural gas. Higher paraffins are derived from a kerosene fraction of petroleum. The requirements herein are principally for detergents and are calculated on the basis of tetradecane as a representative compound. These estimates may be considered low (see Detergents). Although availability of this fraction has not been estimated in the foregoing text, the large quantities of petroleum give assurance that far more than adequate supplies are available.

TABLE 16. REQUIREMENTS FOR MISCELLANEOUS PETROLEUM MATERIALS
(Millions of Pounds)

Year	Kerosene*	Cresylic Acids	Naphthenic Acids	Liquid Petroleum
1955.....	33	14,929	90	1,540
1960.....	40	18,700	115	45
1975.....	68	29,714	175	75

*Includes material for detergents only; calculated on the basis of tetradecane.

†For carbon black only.

The sulfur produced from petroleum and natural gas is derived principally from hydrogen sulfide present in natural and refinery gas. Quantities herein are for total United States requirements. It is not expected that the major sulfur requirements will be supplied from petroleum and natural gas because other large-scale sources are cheaper. However, more than 4% of the present total demand is being supplied from natural and cracked gases, and the amount can be increased up to approximately 10% if necessary. A total of 464 thousand long tons of sulfur could be derived from the present natural

gas and petroleum production, 780 thousand from projected 1955 production, 905 thousand from 1960 production, and 1.27 million from 1975 production.

Cresylic acids are recovered from heavy cracked petroleum distillates. No calculations of availability have been made. It is known, however, that the cresylics could be produced in much greater quantities than at present if the price structure warranted construction of facilities. The projected requirements in Table 16 can be met very easily if additional facilities are installed.

TABLE 17. CHEMICAL REQUIREMENTS FROM HYDROCARBON SOURCES

	Natural Gas		
	1955	1960	1975
Chemical requirements (billion lb.)	32,866	34,654	32,454
Total natural gas:			
Billion lb.....	460	570	900
Trillion cu. ft.....	9.2	11.4	18
% required for chemicals.....	7.14	6.08	3.61
	Petroleum		
Chemical requirements (billion lb.)	14,126	18,764	36,280
Total petroleum:			
Billion lb.....	695	834	1,251
Bbl.....	2.5	3	4.5
% required for chemicals.....	2.023	2.25	2.90

Naphthenic acids are obtained directly from petroleum. No calculations of availability have been made in previous discussion. Although military requirements for flame throwers, jelly bombs, and mine-clearing agents may cause a temporary shortage, there are more than adequate quantities in petroleum to meet the requirements estimated in Table 16.

The percentages of the total natural gas and petroleum production which the requirements given in summary Tables 13-16 would utilize have been calculated. In making these calculations it has been assumed that all the methane and pentanes come from natural gas, and that all the olefins, cyclic compounds, and liquid hydrocarbon fractions come from petroleum. Sulfur has been assumed to come from both sources; the quantities of sulfur used in this calculation are availability figures, not requirements.

The results given in Table 17 show that the chemical requirements can be met through the allocation of small percentages of petroleum and natural gas to that purpose.

Tire Industry in Brazil

The Brazilian tire industry, which started the year 1951 handicapped by shortages of natural rubber and electrical power, was able to operate to capacity during the second half of the year, largely owing to imports of natural rubber and increased supplies of domestic rubber.

Figures for 1951, as compared with those of 1950, show an increase in the production of all types of tires except truck and bus tires, as the following table (in units) shows:

Tires	1951	1950
Truck and bus.....	664,423	671,344
Passenger-car.....	700,753	645,187
Tractor.....	25,064	15,855
Earth-mover.....	8,150	4,180
Industrial vehicles*.....	12,712	
Motorcycle.....	19,741	12,803
Aircraft.....	4,530	3,924
Total.....	1,435,379	1,353,293
Tubes, all types	994,825	880,517

*In 1950 this classification was not used.

Since imports of tires for original equipment are now permitted, it is expected that local output will meet replacement demands for passenger-car tires in 1952. But it is held unlikely that domestic production will in the near future be in a position to cover all needs for heavy-duty tires. Demand for these and other tires is expected to continue strong because of the increasing number of assembly plants being set up in Brazil.

(Continued on page 566)

Editorials

Straws in the Wind for 1953

THE rubber industry, which has just finished another near-record year as far as production and sales are concerned, gives many indications that it is going to establish a brand new record in 1953. Similarly, the plastics industry, which in 1952 may have surpassed its record 1951 year, expects an equally good year in 1953, and if certain things happen in the right way, thinks it might also have another new record at the end of 1953.

It is not too surprising that both of these industries are so optimistic about their prospects in the New Year. The rubber industry has been consuming new rubber for the last three years at an annual rate of about 1,250,000 long tons, and apparently a new high-level consumption rate has been established. The plastics industry now consumes its basic raw materials in almost the same volume, since 1,075,259 and 1,215,704 short tons of resins were used in 1950 and 1951, respectively, and the Society of the Plastics Industry estimates that 1,300,000 short tons will have been consumed in 1952. Here, again, a new high level of consumption seems to have been established, and this new high level is all the more outstanding since in 1941, a little more than ten years ago, the plastics industry consumed only 214,000 short tons of resins. In 1941 the rubber industry consumed 781,259 long tons of natural and synthetic rubbers.

Indications are that of the 1.3 million long tons of new rubber to be consumed by the rubber industry in 1953, between 60% and 65% will be synthetic rubbers. Only between 450,000 and 570,000 long tons of natural rubber will be required to supply the industry's needs in the United States. On this basis a natural rubber price ranging between 25 and 30¢ a pound in 1953 would seem likely, and the rubber should be of better quality by virtue of the recent activities of both the producer and the consumer interests in this connection.

In the plastics industry, expansion in capacity for polyethylene, vinyl, and styrene resins is being constructed, and a large increase in demand for phenolic plastics has been forecast.

The Reconstruction Finance Corp. reports that expansion of GR-S capacity to 860,000 long tons a year "will be essentially completed by January 1, 1953," so that this capacity together with that for the production of butyl, neoprene, and nitrile synthetic rubbers should provide enough synthetic rubbers for 1953 demands. The price for GR-S should remain at 23¢ a pound, although unless additional petroleum butadiene capacity is provided, the use of alcohol butadiene might force some increase in the price for GR-S before the year-end.

Some time during 1953, or at least by mid-1953, the government owned synthetic rubber plants for the production of GR-S and butyl rubbers should be transferred to private industry. Based on forward estimates to 1960,

additional synthetic rubber capacity will be needed, and the construction of such facilities by private industry may be undertaken in 1954 or 1955.

Although the government's synthetic rubber production costs have included many expenses similar to those of private industry, some additional state and local taxes and selling and research expense may necessitate a temporary increase in price when GR-S and butyl rubbers are privately produced. Eventually these prices should range between 20 and 25¢ a pound.

Certain segments of the natural rubber producing industry are trying to institute long-term international commodity agreements for the free market in rubber, and the Working Party of the International Rubber Study Group met in London, England, earlier this month to discuss this problem. It is not likely that the United States will become a party to any such agreement, preferring to let open competition between natural and synthetic rubber decide the amount of the former used in the United States.

The interesting thing about the high level of demand for rubber products is that the volume of defense business amounts to only about 10% of the total. Any reduction in defense spending should not affect materially the degree of activity in the rubber industry. The plastics industry does not appear to be overly concerned about any reduction in defense spending either.

All branches of the rubber industry seem about equally optimistic for an increased volume of business in 1953. Sales volume in 1952 was about equal to that in 1951, but profit after taxes in 1952 was less. Again, a similar situation existed in the plastics industry, and both industries hope that the present excess profits tax law will be allowed to expire in June, 1953, or at least be modified to resemble the old 52% normal business tax.

Supplier companies to both industries would seem also to have pleasant prospects for increased business in 1953. Some rubber companies that are also supplier companies to both industries have taken recognition of this fact. United States Rubber Co., for example, expects a 25% increase in the sales of its Naugatuck Chemical Division in the next two years, an increase which, it was said, will probably be the greatest percentage-wise of any division of the company.

All things taken into consideration, the outlook for 1953 is very promising and even more so because of the anticipated improved government atmosphere in which business can operate. Let us hope that the results 12 months from now will not show that the early 1953 optimism was unjustified.

R. G. Seaman

DEPARTMENT OF PLASTICS TECHNOLOGY

Report on the Shore Type "A" Durometer for Hardness Testing of Vinyl Plastics

Ervine F. Smith¹

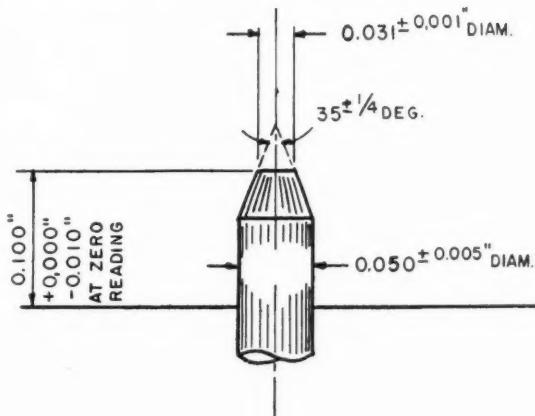


Fig. 1. Dimensions of Indenter Point for Durometer

THE measurement of hardness is seriously handicapped by the lack of a satisfactory definition. Hardness is usually defined in terms of the instrument used to measure it and is reported in arbitrary units.² One of the most widely used instruments for measuring the hardness of rubbers and plastics is the Shore Type "A" durometer³ which covers a useful range and is convenient to use. It is not the purpose of this report to evaluate the Shore instrument in terms of other commercial equipment or to develop a new hardness test, but rather to point out the limitations of the Shore instrument and recommend procedures for its use.

The subject has already been covered in the literature. Two papers, one by Lerrick⁴ and the other by Taylor,⁵ deserve special mention. The data and ideas contained in these two papers have been used freely in this report and

¹Development laboratories, Bakelite Co., Bound Brook, N. J.
²D. Landau, "Hardness," Nitrallloy Corp., 230 Park Ave., New York, N. Y.

³A. F. Shore, "Discussion on Shock and Vibration Properties," pp. 92-97 in "Symposium on Rubber," American Society for Testing Materials, Philadelphia (1943).

⁴"Standardization of Durometers," Am. Soc. Testing Materials, Proc., 40, 1239 (1940).

⁵"Use of the Shore Durometer for Measuring the Hardness of Synthetic and Natural Rubbers," ASTM Bulletin, Aug. 1943, p. 25.

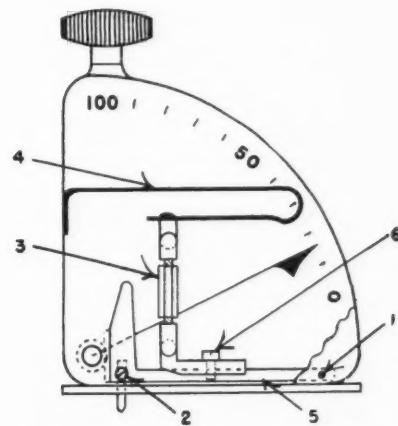


Fig. 2. Schematic View of Type "A" Durometer Mechanism, Showing (1) Indenter Arm Bearing, (2) Indenter Adjusting Screw, (3) Turnbuckle in Load Spring Linkage, (4) Load Spring, (5) Indenter Arm, and (6) Adjusting Screw

have been applied to plasticized Vinylite vinyl plastic.

The Shore Durometer Description

The Shore Type "A" durometer consists of a truncated cone indenter which works against a calibrated spring. The scale reads from 0 to 100.

The specifications for the instrument, as given in ASTM D676-49T, are reviewed below. The dimensions of the indenter are given in Figure 1. The relation of the load, L , in grams on the indenter to the scale reading, S , is given by the following equation

$$L = 7.66 S + 56 \quad (I)$$

The depth of indentation, d , in inches is related to the scale reading

$$d = (100 - S) \times 10^{-3} \quad (II)$$

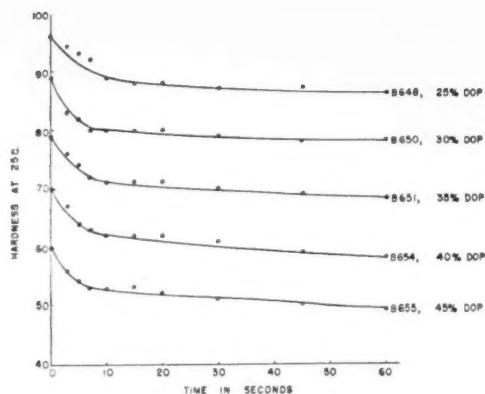


Fig. 3. Durometer Hardness vs. Time of Application of Load

The permissible tolerances are that L may vary from Equation (I) by ± 4 grams at any or all points on the scale, and the depth of penetration for zero scale reading may vary from 0.090- to 0.100-inch (ASTM D676-49T).

Calibration

The mechanism of the durometer is shown schematically in Figure 2. Access is obtained by removing the rear plate of the instrument case. It is necessary to replace this plate after each adjustment before any testing or calibrating operation is performed as one bearing of the indenter arm (item 1, Figure 2) is located in this plate.

The mechanical connection between the indenter and the pointer is such that the indenter may be adjusted (by screw 2, Figure 2) to protrude 0.100-inch below the base plate for zero scale reading. This can be verified with a micrometer microscope. The permissible variation is given above, but it is recommended that it be held between 0.097- and 0.100-inch (ASTM D676-49T).

The actual load on the indenter for any scale reading can be determined with a torsion balance having a capacity of at least 1,000 grams. A suitable foot for the indenter to work against is placed on the sample pan, and the scale balanced. The durometer is clamped in a vertical position over the sample pan with the indenter on the foot. The height of the durometer is adjusted so that the scale is balanced at the desired durometer reading. The weight necessary to maintain this balance is the load on the indenter. The loads for several durometer readings are determined and compared with the values computed from Equation (I). All the observed values can be uniformly increased or decreased by adjusting the turnbuckle in the linkage (item 3, Figure 2) connecting the spring (item 4) to the indenter arm (item 5). The change in load per unit scale reading can be adjusted by loosening the set screw (item 6) and sliding the linkage along the indenter arm. Moving the linkage to the left increases the change in load per unit scale reading.

The above procedure is repeated until the observed values agree with those computed from Equation (I) within the specified tolerance.

The flat tip on the indenter is measured with a micrometer microscope. If this tip does not meet the tolerance shown in Figure 1, or if the edge is worn, the indenter must be replaced.

Durometer Stand

An operating stand for holding the durometer and applying it to the specimen is marketed by the manufacturer. Because of dimensional limitations the stand cannot be used on large or irregularly shaped specimens.

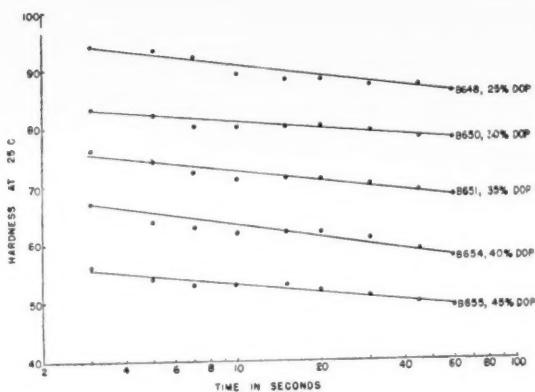


Fig. 4. Durometer Hardness vs. Log of Time of Load Application

Since the specimens used in our laboratories are usually small plaques or piles of sheets, this limitation is not important. The durometer is applied to the specimen by means of a rack and pinion gear to which a knurled knob is attached. The advantage is that it keeps the base of the durometer parallel to the specimen at all times.

The Test Specimen

The test specimens should be conditioned at the test temperature for at least 24 hours prior to testing. The test specimens should be at least 0.25-inch thick, and no measurements should be made nearer than 0.5-inch from the edge.

The dimensional requirements must be strictly adhered to if reliable results are to be obtained. Too thin a specimen gives a hardness value greater than the true value.

The specimens normally used are piles of 0.040- or 0.070-inch sheets, but a single molded plaque is to be preferred. Specimens of both types were used in this investigation.

In the section on results it is shown that when freshly molded specimens are used, a conditioning period of the order of two weeks is necessary.

Test Procedure

The procedure used in applying the durometer manually to the specimen is essentially that given in ASTM D676-49T, which is the method also used by Taylor.⁵ The method is outlined below:

1. The durometer shall be grasped between the thumb and the third and fourth finger, with the index finger resting on the knob of the instrument. The durometer shall be placed on the specimen with the base plate parallel to the surface of the specimen.

2. The pressure applied to the durometer shall be just sufficient to insure firm contact between the base plate and the specimen.

3. The durometer shall be held perpendicular to the test specimen and motionless during the test.

4. The durometer shall be read 15 seconds after application of load except in those cases intended to study the change in durometer reading with time. In these cases readings may be taken at various intervals up to 60 seconds.

Figure 3 is a plot of such data and shows that no rapid change with time occurs after 15 seconds; hence this time was selected as standard for all other measurements.

If the operating stand is used, care must be exercised in its operation since the leverage furnished by the rack

TABLE 1. COMPOSITION, DUROMETER HARDNESS AFTER 15 SECONDS, SLOPE OF THE HARDNESS VS. LOG TIME FOR THREE TEMPERATURES, AND STIFFNESS AT 0 AND 25° C. OF SEVERAL VINYLITE COMPOUNDS

Compound No.	Rosin %	Plasticizer	Hardness after 15 Sec.			Slope of Hardness Log Time Curve			Olsen Stiffness*	
			0° C.	25° C.	50° C.	0° C.	25° C.	50° C.	0° C.	25° C.
B-648	VYNW 72	DOP	89	73	51	-6.3	-4.5	.....	5,610	
B-649	VYNS 72	DOP	82	51	33	-13.1	-8.0	.....	2,550	
B-650	VYNW 67	DOP	80	63	40	-4.0	-7.2	.....	1,570	
B-651	VYNW 62	DOP	91	71	53	-8.3	-5.8	-6.5	5,100	917
B-652	VYNW 62	TCP	73	57	37	-4.7	-6.1	.....	932	
B-653	VYNW 62	TOP	73	57	37	-3.6	-6.0	.....	864	
B-654	VYNW 57	DOP	79	62	47	-7.8	-7.0	-5.6	1,480	613
B-655	VYNW 52	DOP	67	52	40	-6.3	-5.3	-6.3	680	428

* Determined in accordance with ASTM Method D747-48T.

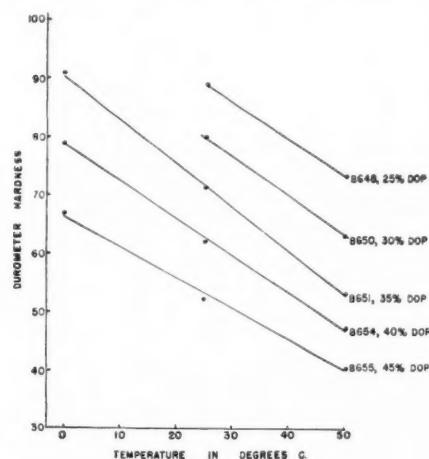


Fig. 5. Durometer Hardness vs. Specimen Temperature

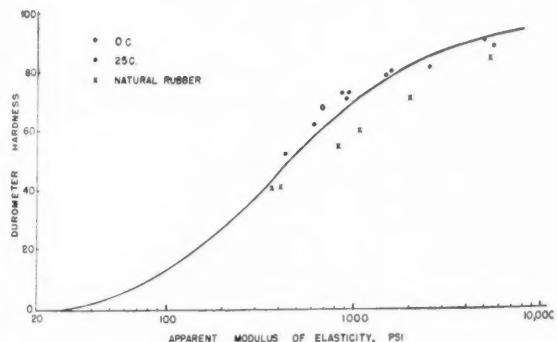


Fig. 6. Durometer Hardness vs. Apparent Modulus of Elasticity

and pinion gear makes it very easy to apply too much pressure. Only enough pressure to bring the specimen in contact with the durometer should be applied. In other respects the procedure is similar to that for the manual method.

Test Results

A series of plasticized Vinylite compounds was used in this study. The compositions are given as a part of Table 1. Unless otherwise specified, the tests were run by the manual method.

The durometer hardness as a function of time of application of the load was determined. In Figure 3 the hardness vs. time is plotted for the DOP plasticized compounds. In Figure 4 these same data are used, but the log of the time is plotted as the abscissa. It is noted that this relation is approximately linear, and that the slope is a rough measure of creep. The slopes are included in

TABLE 2. DUROMETER HARDNESS OF VARIOUS VINYLITE COMPOUNDS

Compound No.	Resin	Type	% DOP	First Observer		Second Observer	
				Plasticizer	First Trial Durometer	Second Trial Durometer	Durometer
B-648	VYNW	DOP	25	92	91	93	91
B-649	VYNS	DOP	25	86	85	87	85
B-650	VYNW	DOP	30	82	80	83	81
B-651	VYNW	DOP	35	73	70	72	71
B-652	VYNW	TCP	35	75	75	75	74
B-653	VYNW	TOP	35	75	73	76	74
B-654	VYNW	DOP	40	60	60	62	60
B-655	VYNW	DOP	45	53	52	53	52

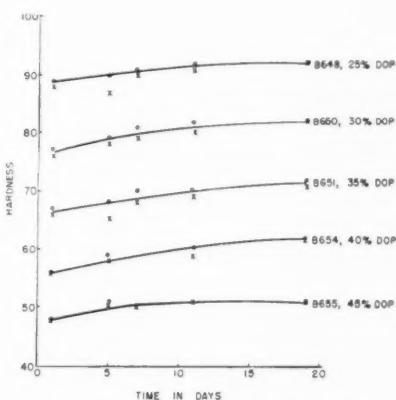


Fig. 7. Increase in Durometer Hardness with Time after Molding of Specimens

the data shown in Table 1. It will be noted that an increase of 1% in the DOP content decreases the hardness by about two units in the range from 25 to 45% DOP.

The 15-second hardnesses were determined at three temperatures (0, 25, and 50° C.) and are included in Table 1. Figure 5 is a graph of the hardness vs. temperature of the DOP compounds. From this graph it can be seen that the hardness changes approximately one unit for each 1.5° C. change in temperature for these compounds in the range from 0 to 50° C.

Measurements at 25° C. were made with two durometers and by two observers, and data are reported in Table 2. From these data it appears that durometer values agreeing within ±2 points can be obtained using a calibrated durometer and following the procedure outlined above.

The depth of indentation is a function of the elastic modulus. By assuming a value of 0.5 for Poisson's ratio, we can derive the following equation relating the elastic modulus and the hardness reading:

$$E = \frac{53.2 (7.66 S + 56)}{100 - S} \quad (III)$$

In Table 1 the stiffness values of the various compounds at 0 and 25° C. obtained with the Olsen stiffness

tester (ASTM D747-48T) are given. The log of the stiffness, or apparent modulus of elasticity, is plotted against the durometer hardness in Figure 6. Also included are some data obtained on natural rubber by Williams.⁶ For Williams' data the elastic modulus was determined in compression. The line in Figure 6 is the theoretical relationship between durometer reading and elastic modulus obtained from Equation (III). It is recognized that this equation applies to a right circular cylinder, and that the indenter is a truncated cone. The materials used in this study, however, did not touch the sides of the cone during the test; hence Equation (III), is deemed applicable. Considering the difficulties in measuring an apparent modulus of elasticity, the agreement between the observed points and the theoretical curve is considered good. Lichtman and Chatten⁷ have shown indentation hardness to be a function of flexural modulus for several natural and synthetic rubbers.

It is customary to prepare a durometer specimen by piling up a number of thin sheets until the desired thickness is obtained. The data reported in Tables 1 and 2 and Figures 3 to 6 were obtained from such specimens. Table 3 shows the effect of specimen thickness on hardness of 25 and 45% DOP compounds. These data were obtained by taking readings on a single sheet of material and then adding one sheet at a time and taking additional readings. The data show that the ASTM requirement of 0.25-inch thickness for a specimen is a minimum and must be rigidly followed.

TABLE 3. HARDNESS AS A FUNCTION OF SPECIMEN THICKNESS

Thickness in Inches	Hardness	
	B-648 - 25% DOP	B-655 - 45% DOP
0.082	93	63
0.164	92	57
0.246	92	55
0.328	92	54
0.410	..	53
0.492	..	53
0.574	..	53

TABLE 4. COMPARISON OF HARDNESS OF $\frac{1}{2}$ -INCH THICK MOLDED PLAQUES AND PILED SHEETS

Compound No.	% DOP	Piled Sheets	Average Durometer Hardness		
			Molded Plaques Days after Molding		
			1	11	19
B-648	25	92	88	91	92
B-650	30	81	76	81	82
B-651	35	72	66	69	71
B-654	40	61	56	59	62
B-655	45	52	48	51	52

To investigate the effect of making measurements on a pile of sheets rather than a molded specimen, $2 \times 3 \times \frac{1}{2}$ -inch plaques were molded from the VYNW-DOP series of sheets. The plaques were aged 24 hours, and the hardness was measured. The values obtained, see Table 4, were four to six units less than those obtained for the piled specimens. The specimens were retested after five, seven, 11 and 19 days. The values obtained after 19 days agree with those obtained on the piled specimens. The change in hardness with time elapsed after molding is shown in Figure 7.

It will be observed that there is very little change between the eleventh and nineteenth days.

Table 5 gives comparative hardness values obtained by the manual and operating stand methods. It is observed that the results obtained are equivalent.

TABLE 5. COMPARISON OF HARDNESS MEASUREMENTS MADE WITH AND WITHOUT DUROMETER STAND

Compound No.	% DOP	Average Durometer Hardness	
		With Stand	Without Stand
B-648	25	92	92
B-650	30	82	82
B-651	35	72	71
B-654	40	62	62
B-655	45	52	52

Summary and Conclusions

Shore Type "A" durometers have been calibrated as specified in ASTM D676-49T "Standard Method of Test for the Indentation of Rubber by Means of the Durometer." They have been used to measure durometer hardness of several plasticized Vinylite compounds under various conditions. Durometer hardness is a function of: (1) the time elapsed between application of load and reading; (2) the temperature; (3) the elastic modulus; (4) age of specimen.

For Vinylite VYNW-DOP compounds in the range of 25-45% DOP the durometer hardness decreases approximately two units for each % increase in plasticizer, and for these compounds the hardness decreases about one unit for a temperature increase of $1.5^{\circ} C.$ in the range from 0 to $50^{\circ} C.$

The procedures for the calibration and use of the durometer are given. If these are followed, consistent results can be obtained by experienced operators.

⁶"Hardness and Hardness Measurements," pp. 321-48. American Society for Metal, Cleveland (1942).

⁷"Physical Properties of Natural and Synthetic Rubber Materials at Low Temperatures," Anal. Chem., 24, 812 (1952).

Meetings and Reports

SPI Film and Sheeting Conference

THE fourth annual conference of the Plastics Film, Sheeting & Coated Fabrics Division, Society of the Plastics Industry, Inc., was held December 4-5 at the Hotel Commodore, New York, N. Y. A total registration of some 360 members and other interested persons was noted at the conference, which included morning and afternoon sessions devoted to technical, merchandising, and other subjects.

THURSDAY MORNING, DECEMBER 4

William Merton, Rubber Corp. of America, presided over the opening session

which consisted of four talks, as follows: "Flammability Studies with the SPI Tester," Joseph R. Darby, Monsanto Chemical Co. Results obtained with the SPI flammability tester on vinyl chloride film and sheeting show it to be a highly sensitive instrument. The design and the operation of the tester were described in detail, and extensive test data were presented on results obtained with commercial films.

"New Trends in the Finishing of Vinyl Film and Sheeting," Dale G. Higgins, John Waldron Co. Finishing techniques for film and sheeting include deco-

rative variations such as printing, embossing, flocking, topping, and coating; and construction variations such as laminating, quilting and bonding. The effect of conversion on film or sheeting quality is often overlooked. Convertors should insist on engineering redesign of their equipment to insure product quality and permanence of finish. The major trends in the industry are an increase in the popularity of the ink embossing technique, an increase in the use of the embossing-lamination technique, and a continuing trend toward conversion as a custom finishing job.

"The Practical Value of Test Methods

in Vinyl Film and Sheeting." H. M. Quackenbos, Jr., Bakelite Co. While ignoring the value of tests to determine selection of a plasticizer is an unsatisfactory procedure, the use of too many tests can often cause confusion and give equally unreliable results. The three steps in the selection of tests to determine plasticizer efficiency are: (1) select the important properties required for a specific application; (2) decide whether the laboratory test methods for these properties are realistic or remote from actual service; and (3) determine how far apart test results must be before a significant difference can be determined.

"Fashion and Design Aspects in the Vinyl Film and Sheeting Industry," Edgar Kaufmann, New York Museum of Modern Art. More emphasis on design and styling and less imitation of other materials and their patterns are needed by the vinyl film and sheeting industry to meet public demand. Modern design utilizing the unique properties of the plastic is needed to capitalize on the demand for progressive styling.

THURSDAY AFTERNOON, DECEMBER 4

Gordon Brown of Bakelite and SPI president, presided over the luncheon and the panel discussion which followed on the subject, "Who Can Contribute the Most to the Future Sales Expansion of Vinyl Products—the Manufacturer or the Retailer?" Charlotte Montgomery, *Tide* magazine, acted as moderator, and panel members were Thomas Ryan, J. C. Penney Co., representing the chain stores; James E. Entin, R. H. Macy & Co., representing the department stores; A. A. Sachs, Sears, Roebuck & Co., representing the mail-order houses; David S. Plumb, Monsanto, representing the resin producers; Dorothy M. Rice, Rubber Corp., representing the film processors; and Joseph Kaplan, Comprehensive Fabrics, Inc., representing the film fabricators.

In introducing the discussion, Mr. Brown decried the trend toward cheaper and poorer products and called for the establishment of product standards and better management and sales techniques. Mr. Ryan stated that both the retailer and the manufacturer must contribute to future sales expansion and urged a new emphasis on styling and quality. Mr. Entin declared that there is nothing wrong with the vinyl film and sheeting industry that a feeling for its product could not cure. Mr. Sachs deplored the efforts of retailers to mislead the public and the trend toward cheaper products. He asked for industry-wide efforts to maintain quality and educate the consumer as to the selection and properties of plastics.

Mr. Plumb, who forecast that more than 160,000,000 pounds of calendered vinyl film and sheeting will be produced in 1953, stated his belief that the ills now confronting the industry were essentially growing pains. Resin producers feel the problem now is one of price, with products cheapened under the pressure of retailers and fabricators demands for lower costs. Mr. Plumb also stated the need of product quality and less "corner cutting." Miss Rice recommended an end to the imitation of other materials and the misuse of end-products and expressed the belief that concerted action by retailers, processors and fabricators is needed to improve quality and design. Mr. Kaplan stated that there are too many opportunists among both buyers and sellers of vinyl film, and the major problem now is to reestablish a proper understanding and apprecia-

tion of film in the minds of both producers and consumers. He suggested a major advertising campaign by the resin producers to educate the public and refute misunderstandings.

FRIDAY MORNING, DECEMBER 5

Three talks were given at the morning session, presided over by Chester Robbins, Interchemical Corp.

"Progress Report on the Vinyl Film Standard," William T. Cruse, SPI executive vice president. The history, use, and advantages of the SPI-sponsored proposed commercial standard for vinyl film were discussed. This standard is now being circulated among the industry by the United States Department of Commerce and, upon being approved by 65% of the industry, will be formally issued by the Department's Standards Division.

"The Future in the Vinyl Upholstery Field," Nat Ancell, T. Baumritter Co., Inc. Future expansion of vinyl upholstery applications depend on improvements in design, style, and color; the need of quality standards; recognition that low cost is not enough in itself; engineering modifications of furniture to further the use of vinyls; technical improvements such as modifying the non-breathing quality of film and sheeting, and developing adhesives for covering wood with vinyl; promoting the use of vinyl upholstery in better-class fur-

niture as a background for mass-produced, low-cost furniture.

"The Federal Trade Commission and Its Functions," D. C. Daniel, FTC secretary. The organization and functions of the Commission were described in detail, together with some of its work in the past in improving product quality and in the ending of product misrepresentations.

FRIDAY AFTERNOON, DECEMBER 5

The concluding session of the conference consisted of a luncheon presided over by Bernard Mittman, Elm Coated Fabrics Co., followed by a talk and demonstration of vinyl product quality by Roy K. Marshall, noted astronomer and television commentator. Using typical vinyl film and sheeting products purchased from retail stores, and including such items as raincoats, drapes, shower curtains, garment bags, and aprons, Dr. Marshall showed how many of these products are inferior in quality and misrepresented to the consumer. These poor items are made and sold by companies interested only in making quick profits, but they give the industry a bad name and discourage repeat sales. A common-sense approach to product quality and merchandising is needed before further expansion of the film and sheeting industry can take place, Dr. Marshall declared.

More on SPE National Conference

ADDITIONAL abstracts of technical papers to be presented at the ninth annual National Technical Conference of the Society of Plastics Engineers, Inc., have been received. The Conference will be held January 21-23 at the Hotel Statler, Boston, Mass. The program and initial batch of abstracts appeared in our December issue, page 376. Additional abstracts follow:

"Biaxially Oriented Polystyrene and Methyl Methacrylate," C. P. Fortner, Plax Corp. Theories pertinent to orienting plastics are reviewed, and new data presented on the properties of biaxially oriented polystyrene and methyl methacrylate. These data include outdoor and accelerated weathering tests that indicate the oriented polystyrene sheet to be superior to unoriented material in weather resistance. Equipment and production problems for making oriented sheet are discussed.

"Vinyl Floor Coverings," Robert K. Petry, Delaware Floor Products Division, Congoleum-Nairn, Inc. The history of early hard-surface floor coverings is reviewed, including linoleum printed felt base, rubber tile, and asphalt tile. The development of vinyl floorings is described in detail, including early experimental tiles, continuous decorated calendered sheets, and printed sheets. Current types of vinyl floorings include flexible and semi-flexible solid tiles; supported calendered vinyl wear layers in both sheets and tiles; and printed floorings in two styles, as follows—(1) clear vinyl wear layers over a rotogravure printed design, and (2) vinyl print on asphalt saturated felt. Advantages of vinyl floorings include product quality, ease of processing, versatility of application, adaptation to existing processing equipment, price stability of raw materials, and relatively low capital investment for manufacturing.

"Plastics Engineered for Relief Map Reproduction," John J. Gurtowski, Relief Map Division, United States Army Department. The increased demand for plastics relief maps by the Armed Services and the probable eventual use of such maps in educational institutions and other civilian applications emphasize the need of a reevaluation of the materials now employed in the maps, and the need of material improvements to overcome the problems resulting from increased production. The plastics industry will be asked to tighten the thickness tolerances and improve the printing surfaces of its sheets. New and better printing inks must be developed for high-speed offset printing, and new sheet materials developed to meet the demand for low-temperature flexibility. Stable, low shrinking, temperature- and flame-resistant casting resins are needed for lightweight library molds. Stable, lightweight fillers and binders are needed for making production molds. Finally, a casting material is needed to replace the plate glass used in negative printing.

"Techniques of Injection and Compression Molding Polytrifluorochloroethylene," C. R. Giannotta, M. W. Kellogg Co. A brief discussion is given of the basic polymers, forms, and grades being produced by Kellogg under the trade name, Kel-F. An explanation of the "No Strength" temperature test for control of the polymer and fabricated part is given, together with a description of polymer properties. Compression, injection, transfer, and plunger molding of Kel-F are discussed in detail, including molding cycles, mold heating and cooling, handling of the molding powder, mold design, and so forth.

"Vinyl Compounding," M. S. Greenhalgh, General Electric Co. New types of vinyls, including rigid materials, elas-

tomerized plasticized vinyls, monochlorotrifluoroethylene, and others, have presented new problems to the industry. These problems are discussed, together with developments in materials and processing equipment during the past few years.

Series on extrusion by speakers from E. I. du Pont de Nemours & Co., Inc.

"Some Principles of Plastics Screw Extruders," W. L. Gore. The operational principles of a plastics extruder are described in general terms, and an equation is given for calculating output, pressure, and power. The principles for scaling up from small to large extruders are discussed, and the "cube" rule is given for geometrically similar extruders. The nature of the operating characteristic curve for extruders is also discussed.

"Operating Characteristics of Extruders," James F. Carley. Operating characteristics for extruder dies and screws are defined, and their relation is explained. Several different screws are described, with emphasis on their characteristics. Data are given and explained on the actual characteristics during extrusion of Alathon and Lucite. Some conclusions are drawn regarding the types of screws needed for different extrusion jobs.

"The Design of a Screw for Plastics Extruders," J. M. McKelvey. The actual calculations of screw dimensions for a specific job are outlined. The basis of the calculations is described, together with the approximations involved. Performance data are cited for several different extruder screw designs.

"Closed Mold Molding Techniques," Edward F. Borro, Sr., Durez Plastics & Chemicals, Inc. The elements involved in the successful use of closed mold molding are practical part design; selection of the right material; mold design; gate and runner size; position of gates; and transfer and clamping pressures. Pertinent data on dimensional stability and accuracy, mold wear, and the effects of molding on electrical and physical properties are also included in the discussion. (This paper is part of the SPE Professional Activities Committee panel discussion).

Section Reports

Vacuum Metallizing Discussed

A talk on "High Vacuum Metallization" by William Dolke, Distillation Products Industries, highlighted the November 18 dinner-meeting of the Ontario Section, SPE, held at the St. Regis Hotel, Toronto, Ont., Canada. Colored slides were used by the speaker to illustrate his talk, and the speech was followed by a lively discussion period.

Mr. Dolke stated that there are three basic patterns of metallizing plastics, as follows (1) rear surface metallization on transparent molded plastics, as with automobile escutcheons; (2) metallization of film and sheets of cellulose acetate, cellulose acetate butyrate, and styrene for the fabrication of sequins and ribbons; and (3) front surface metallization of molded items of various plastics to enhance their appearance and sales appeal. Front-surface metallization lends itself to special surface effects and also permits use of reground plastic materials of mixed colors in the molded item.

The speaker described the process of front surface metallization in detail, including the use of under- and over-coatings of lacquer, the metal to be coated on to the plastic, equipment required, and comparative costs of the high vacuum method and other metallization techniques. In view

of its lower operating costs per unit, the high vacuum method will replace other metallization processes, Mr. Dolke predicted.

CALENDAR

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| Jan. | 19. Plant Maintenance Conference
22. and Show. (Special Rubber Industry Sessions, Jan. 20-21)
Public Auditorium, Cleveland, O. |
| Jan. | 19. American Institute of Electrical Engineers. Winter General Meeting. Hotel Statler, New York, N. Y. |
| Jan. | 20. Elastomer & Plastics Group, Northeastern Section, A. C. S. Massachusetts Institute of Technology, Cambridge, Mass. |
| Jan. | 21. Washington Rubber Group. |
| Jan. | 21. Society of Plastics Engineers. |
| | 23. Annual Technical Conference. Hotel Statler, Boston, Mass. |
| Jan. | 23. Philadelphia Rubber Group. Poor Richard Club, Philadelphia, Pa. |
| Jan. | 25. National Sporting Goods Assn. Convention and Show. Hotel New Yorker, New York, N. Y. |
| Jan. | 28. Chicago Rubber Group. Morrison Hotel, Chicago, Ill.
Akron Rubber Group. Mayflower Hotel, Akron, O. |
| Feb. | 3. The Los Angeles Rubber Group, Hotel Statler, Los Angeles, Calif. |
| Feb. | 5. Northern California Rubber Group.
Fort Wayne Rubber & Plastics Group. Van Orman Hotel, Fort Wayne, Ind. |
| Feb. | 11. Newark Section, SPE. Military Park Hotel, Newark, N. J. |
| Feb. | 13. Detroit Rubber & Plastics Group, Inc. |
| Feb. | 17. Elastomer & Plastics Group, Northeastern Section, A. C. S. |
| Feb. | 18. Washington Rubber Group. New York Section, SPE. Hotel Gotham, New York, N. Y. |
| Feb. | 18. SPI Reinforced Plastics Division. Shoreham Hotel, Washington, D. C. |
| Mar. | 1. American National Red Cross.
31. Annual Campaign for Funds. |
| Mar. | 2. ASTM. Spring Meeting. Detroit, Mich. |
| Mar. | 5. Northern California Rubber Group. |
| Mar. | 10. Society of Plastics Industry (Canada), Ltd. Eleventh Annual Conference. General Brock Hotel, Niagara Falls, Ont., Canada. |
| Mar. | 11. Newark Section, SPE. Military Park Hotel, Newark, N. J. |
| Mar. | 17. Elastomer & Plastics Group, Northeastern Section, A. C. S. |
| Mar. | 18. Washington Rubber Group. New York Section, SPE. Hotel Gotham, New York, N. Y. |
| Mar. | 15. American Chemical Society, Los Angeles, Calif. |
| Mar. | 16. National Assn. of Waste Material Dealers, Inc. Fortieth Annual Convention. Conrad Hilton Hotel, Chicago, Ill. |
| Mar. | 18. Division of Rubber Chemistry. 20. A. C. S. Hotel Statler, Los Angeles, Calif. |
| Mar. | 27. Chicago Rubber Group. Morrison Hotel, Chicago, Ill.
Akron Rubber Group. Mayflower Hotel, Akron, O. |
| Apr. | 7. The Los Angeles Rubber Group, Inc. Hotel Statler, Los Angeles, Calif. |

Chicago Sections Celebrate

The third annual joint Christmas party of the Chicago Section, SPE, and Midwest Chapter, SPI, took place on December 9 at the Edgewater Beach Hotel, Chicago, Ill. More than 370 members and guests attended the affair, which included a free cocktail hour, dinner, floor show, and an evening of dancing. Arrangements were handled by Warren Cooper, Tennessee Eastman Corp., and Wm. K. Woodruff, Celanese Corp. of America.

Miami Valley Officers

The Miami Valley Section, SPE, held a very successful Christmas party on December 5 at the Hartwell Country Club, Hartwell, O. Members and their wives attended the affair, which included dancing, games, refreshments, and a buffet supper. R. N. Backscheider, Recto Molded Products, Inc., was in charge of arrangements for the party and was assisted by C. E. Weber, Crosley Division, Avco Mfg. Corp.; and J. P. Merke and M. F. Nelson, both of Plastic Moldings Corp.

New officers of the group were announced, as follows: president, Mr. Merke; vice president, Mr. Backscheider; secretary, C. L. Ackerman, Crosley Division; and treasurer, J. R. White, Buckeye Molding Co. Newly elected to the Section's board of directors are Mr. Ackerman; F. L. Strobino, General Electric Co.; and R. A. Wright, Dimco-Gray Co.

New York Party

A record attendance of 145 members and guests and an outstanding floor show highlighted the fourth annual Christmas party of the New York Section, SPE, held on December 17 at the Gotham Hotel, New York, N. Y. The program consisted of a cocktail hour, dinner, entertainment program, and the distribution of table favors and door prizes. Arrangements for the party were handled by Saul Blitz, Noma Electric Corp.

In a brief business session preceding the show, the retiring president, Bruno E. Wessinger, Wess Plastic Molds, Inc., reported on the Section's growth and progress during 1952 and introduced the new officers and directors for the coming year, as follows: president, Mr. Blitz; vice president, Harold H. Schwartz, Empire Brushes, Inc.; secretary-treasurer, William Lewi, Dusal Tool & Mold Co.; national director, Stanley Bindman, Jamison Plastic Corp.; and local directors, (one year) Mr. Blitz, Russell H. Skidmore, Celanese Corp. of America, and A. M. Merrill, India RUBBER WORLD, (two years) Messrs. Lewi and Schwartz, and J. Martyn Voegten, Celanese Corp., and (three years) G. Palmer Humphrey, R. C. Molding, Inc., Arthur S. Jacobs, Ideal Toy & Novelty Corp., and Richard M. Thews, Monsanto Chemical Co.

Mr. Wessinger also thanked the officers, directors, and members for making 1952 a successful year in the Section's history, and Mr. Blitz expressed the hope that the group would continue to grow during the coming year. Continuing the custom established last year of presenting a gift to the retiring president, Mr. Blitz presented Mr. Wessinger with a handsome

(Continued on page 526)

Scientific and Technical Activities

Chicago Group Symposium on GR-S Compounding

A PANEL discussion on "GR-S Compounding in the Rubber Industry" featured the November 21 dinner-meeting of the Chicago Rubber Group, Inc. About 190 members and guests attended the meeting held in the Morrison Hotel, Chicago, Ill. C. S. Yoran, Brown Rubber Co., acted as moderator, and the panel members were H. A. Winkelmann, Dryden Rubber Division, Sheller Mfg. Corp.; R. N. Hendriksen, Corduroy Rubber Co.; J. S. Kramer, La Crosse Rubber Mills Co.; J. B. Braden, Industrial Rubber Goods Co.; E. C. Svendsen, United States Rubber Co.; and A. F. Reznicek, Office of Synthetic Rubber, Reconstruction Finance Corp.

The discussion consisted of short talks by the moderator and panel members, followed by a question-and-answer period. The meeting closed with a drawing for door prizes, which were won by H. L. Patt, Big Ben Petroleum Co., and J. Hanley, Vail Rubber Works, Inc.

GR-S in Sponge Rubber Goods

Following a general introduction to the panel discussion, Mr. Yoran gave a brief history of the use of GR-S in sponge rubber goods. Following the war it was found that alum-coagulated GR-S polymers were less tacky on mills and calenders after being sufficiently plasticized to blow properly. The first polymer used was GR-S-20AC, but was unsatisfactory for automotive sponge because it contained an antioxidant that stained auto finishes. This staining problem was solved with the development of GR-SX-317 which later became GR-S-45AC.

In order to eliminate the plasticizing step required with GR-S-45AC, another new polymer was then developed, GR-S X-421, later designated GR-S-30AC. While there have since been minor changes in modifier, antioxidant, shortstop, etc., GR-S-30AC is still widely used for sponge goods and now has the code number designation GR-S 1010.

The sponge rubber industry has continued to use high percentages of GR-S as compared to total rubber hydrocarbon because breakdown time is reduced and Banbury capacity increased. Other advantages include less staining than a natural rubber adequately protected with an antioxidant, no tendency to reversion on overcures, better skin forming ability, and better ozone resistance of the applied skin.

Further improvements in GR-S polymers are expected in the future, including low-temperature polymers, variations in styrene content, and oil masterbatches. The added strength of cold rubber would be desirable in sponge goods, and lower styrene contents might improve the low-temperature properties of the polymer, Mr. Yoran concluded.

GR-S in Mechanical Goods

Dr. Winkelmann spoke on the use of GR-S in mechanical rubber goods, noting that widespread usage took place after the war despite the inherent defects of GR-S and the lack of know-how in compounding and processing. The recent introduction of cold, arctic, and low water absorption

GR-S polymers has served to illustrate the versatility of the rubber in permitting tailor-made polymers for specific applications.

GR-S is cleaner than natural rubber and more uniform in plasticity and rate of cure. The synthetic is also more resistant to oxygen, elevated temperatures, ozone cracking, and outdoor weathering, shows less tendency toward reversion, and is superior in abrasion resistance. The improvement in electrical properties and water resistance is such that GR-S will probably continue to be used in applications requiring these properties regardless of natural rubber price. Arctic types are also widening the use of GR-S in the sub-zero temperature field.

GR-S shows poorer hot tear, lower resilience, and greater hysteresis loss than natural rubber. The former has low tensile strength in pure gum compounds, although non-black stocks with good physical properties can be made by using a silica filler. A decline in natural rubber prices below the GR-S level will decrease the use of GR-S, but where processing and quality are important, GR-S is preferred and will hold its own, Dr. Winkelmann declared.

GR-S in Tires

Discussing the use of GR-S in tires, Mr. Hendriksen noted that the postwar tire industry started with standard GR-S, progressed to GR-S-AC, next went to GR-S-10, and then to carbon black masterbatches. Today, with the trend toward HAF blacks, cold rubber has yielded 20-30% better tread wear than was possible with natural rubber. Tire men have utilized cold rubber not only in auto and light truck treads and sidewalls, but also in carcass stocks in blends with natural rubber. Cold rubber is easier to process, less scorchy, better aging in the uncured state, and more uniform in extruded shapes.

On the other hand, cold rubber has not completely eliminated the problems which arise from overloading, high heat buildup, cutting, and chipping on large, heavy-duty truck and off-the-road tires. Tests of cold rubber compounded with SAF black, however, have shown service on heavy-duty tires to be almost as good as obtained with natural rubber. An important recent product of the RFC experimental program is oil extended cold rubber, using an oil content of 25-50 parts. These oil-black polymers yield a 10-20% improvement over regular cold rubber in tread wear at a substantial saving in cost.

As regards the future of GR-S in tires, two new types are still undergoing experimental development. One of these, the Alfin rubbers, were formerly very tough and difficult to process, but, when made by oil masterbatching, show processing and dynamic properties superior to those of cold rubber and approaching natural rubber. The other new type of GR-S approaching cold rubber in physical properties, which can be made without refrigeration, utilizes the Nitrazol CF (aromatic nitrogen diazo compound) catalysts. The tire industry feels optimistic about the future of GR-S, Mr. Hendriksen said in closing.

GR-S in Footwear

Speaking on the use of GR-S in footwear, Mr. Kramer gave the advantages over natural rubber as being (1) reduced pressing, book marking, and distortion of calendered sheets in storage; (2) reduced blistering during vulcanization owing to moisture in the fabrics; (3) reduced sagging of unsupported calendered sheets during vulcanization; (4) less breakdown required before mixing or calendering; (5) better calendering and retention of design; and (6) improved resistance to flex cracking in the finished product. Disadvantages resulting from the use of GR-S include (1) loss of building tack; (2) low quality of colored stocks; (3) stiff, high modulus stocks because of high loadings of reinforcing fillers needed for low shrinkage and high quality; and (4) high shrinkage of non-cross-linked GR-S polymers.

The most important single disadvantage of GR-S in rubber footwear is the loss of building tack, since natural rubber requires very little cementing to secure adhesion between rubber surfaces. GR-S has been used for the most part in blends with natural rubber to obtain some of its advantages while minimizing the disadvantages. During the last period of natural rubber restrictions the footwear industry used a minimum of 30% GR-S in blends with natural rubber.

The only polymer available 10 years ago was standard GR-S, but by the end of the war non-staining GR-S-50 was widely used in footwear. When low shrinkage, cross-linked GR-S-60 and non-staining GR-S-62 became available, they were widely used in blends with other GR-S polymers and natural rubber. Recently the rosin acid emulsified cold-rubber polymers, such as GR-S-100, X-625, and GR-S 1501, have been used in combination with natural rubber and GR-S-62 to obtain higher quality and better building tack. It has been necessary to blend some cross-linked polymer with these cold rubbers to reduce shrinkage.

Currently, the RFC has a program to produce improved cross-linked polymers with low shrinkage and higher quality. Some of these new experimental polymers have shown promising results, Mr. Kramer stated.

GR-S in Extruded Goods

Mr. Braden spoke on the use of GR-S in extruded goods, noting that it is superior to natural rubber in factory processing, but weaker in strength and shows less freedom of compounding. With natural rubber, nerve could be removed by heat or mechanical breakdown; while with GR-S the nerve must be compounded out.

There is little choice among the common types of GR-S as to extrudability. Polymers of higher styrene contents do tend to extrude more smoothly, but cross-linked or divinyl benzene polymers aid extrusion at the expense of physical properties. For high-quality extruded goods it is usually necessary to use a high-structure black either alone or in combination with other pigments. Here the compounder must be cautious in his high temperature mixing conditions which may tend to cause gel formation in the GR-S.

or the formation of a carbon-gel complex. Thermal blacks and mineral fillers can be used if the stock is loaded high enough.

Appearance of the finished extrusion will depend on the selection of processing aids, resins, waxes, peptizers, plasticizers, and extenders. Also of importance in production of good extruded stock is control of the mixing cycle and Mooney viscosity to assure uniformity in the batch and from batch to batch. Extruded goods of today are run to very close tolerances; in most cases the extruded section is magnified 10 times, and is shadow superimposed on the blueprint as a control. Mr. Braden noted that it is not uncommon to hold tolerances as close as $\pm 1/64$ -inch.

GR-S in Foam Rubber Goods

The use of GR-S in foam rubber was the topic of Mr. Svendsen's talk. The scarcity of GR-S latex is the chief handicap to broader use of the material, since demand has exceeded supply ever since the cold types became available. Although no one is manufacturing foam products from 100% GR-S latex, the improved tensile strength of the cold polymers permits use of larger proportions of GR-S to natural latex. Selection of GR-S latex type is as important or more important than compounding in order to obtain the best final product properties.

Compounding of GR-S latex follows along the same lines as natural latex. Since the initial tensile strength is low, prevention of overcuring is essential. In general, GR-S latex is more tolerant to the addition of chemicals than is natural latex. Although the usual precautions of wetting down pigments into slurries, and emulsifying hydrophobic liquids must be followed, GR-S latex compounds are ordinarily more stable than similarly compounded natural latex. This stability is probably due to the soap system of stabilizers and the absence of ammonia which activates zinc oxide.

The adjustment of stability is a major factor in latex compounding to achieve good processing. Studies of particle size distribution are helpful, and a knowledge of the soap system of the particular latex being used is necessary. It also appears that the use of a good heat stabilizer is a necessity, but the highly cross-linked latex polymers seem fairly resistant to accelerated aging tests. In the final analysis, GR-S latex has already been given acceptance on a large scale for both economic and quality reasons, and its future in foam goods should be bright. Mr. Svendsen declared.

Office of Synthetic Rubber, RFC, Technical Service

The final talk was given by Mr. Reznicek on the functions of the technical service branch of the Office of Synthetic Rubber, RFC. In general, this branch is a means of liaison between consumers and the various OSR divisions. This branch is publishing a catalog giving the pertinent chemical and physical properties of the various polymers in condensed, usable form. Part of this catalog is now being printed, and as additional information is compiled, supplementary pages and sections will be published.

Early in 1952 a new number system was put into effect for established GR-S polymers, and the total number of polymers reduced from more than 100 to 65. A further reduction in the number of polymers has been established as future policy and is a specific responsibility of the technical service branch.

Recent shipments of GR-S show that more than 50% of industry requirements are for cold polymers totaling 12 in number; the balance of demand is for some 56 polymers, of which 36 are hot polymers. Most users of these hot polymers should find quality advantages with no economic disadvantages in changing to cold polymers. There are exceptions, however, and work is being done toward bridging these gaps with satisfactory cold polymers.

With the oil-masterbatched cold polymers, interchangeability of certain oils and the possible elimination of certain polymers containing lower proportions of oils should permit narrowing that group to about six polymers. It is also evident that two of the present five cross-linked hot polymers can serve all requirements. Mr. Reznicek stated. Perhaps one cross-linked hot polymer can be developed to serve in place of all five with quality improvements, or two of the hot black-masterbatched polymers could be replaced with one cold oil-black masterbatch polymer with quality and economic advantages.

There is no intent or inclination to reduce the number of polymers at the expense of new and improved ones. Rather, it is believed that each new polymer should be justified for quality or economic reasons and then replace the one or more polymers to which it is superior.

Question-and-Answer Period

1. Q. Does the selection of GR-S polymer influence the weather aging characteristics of compounds formulated from the polymer?

A. Winkelmann. There is no difference between the commercially available hot and cold types of GR-S with respect to weather aging. The oil extended types are not as good as the standard types in this respect.

2. Q. Does the type of curative or plasticizer have any effect on the scumming of metal molds? How can scumming be prevented?

A. Winkelmann. Tetramethyl thiuram disulfide causes scumming of molds, and certain oils and plasticizers have a tendency to bloom out during the cure and cause scumming.

A. Braden. Many people make a mistake in improper cleaning of their molds. They should get down to the metal in the cleaning process and attempt to prevent scum from building up by protecting the metal surface.

3. Q. What do you consider the best heat-resistant accelerator combinations for GR-S?

A. Tetramethyl thiuram disulfide by itself or in combination with mercaptobenzothiazole or benzothiazyl disulfide. Also tetramethyl thiuram monosulfide with low sulfur ratio. Another suggestion is the use of compounds of selenium and tellurium as activators.

4. Q. Please explain how to get smooth low-durometer extrusions with mineral fillers.

A. Braden. It is not being done. It is difficult to go under 55 durometer even with high amounts of oils and plasticizers. What is needed is possibly a new type of GR-S or a new peptizer.

5. Q. What is the practical percentage of GR-S to natural rubber in blends in foam rubber production?

A. Svendsen. At the same price for natural rubber latex and GR-S latex, the natural would be used because of greater strength. At present there is about 10¢ per pound advantage in price in favor of GR-S.

The quantity used varies from one product to another.

6. Q. Are 3000 psi. tensile values practical for specification use?

A. Hendriksen. No. The buyer should specify the special characteristics which he desires rather than such high tensile strengths. High tensile stocks do not always meet special requirements such as compression set, age resistance, etc.

A. Winkelmann. With hot GR-S it is practically impossible to get 3,000 psi. tensile strength and also obtain desirable characteristics. It is possible with cold GR-S in a high-quality 60 hardness compound. Other properties, however, often are more important than tensile strength and need to be stressed. These include flexing, compression set, weather aging, low temperature properties, etc.

A. Braden. Three thousand psi. tensile strengths are not practical in extruded GR-S compounds.

7. Q. Is it practical to use GR-S compounds in mechanical goods without added antioxidant?

A. Reznicek. No, not a general thing; however, each case should be decided on its own merits. The common "antioxidants" are added during polymerization to serve as "stabilizers" during the drying process and storage prior to use in compounds. They are not necessarily sufficient to protect the finished product.

8. Q. What progress has been made toward eventual 100% use of GR-S in footwear?

A. Kramer. Compounds are working toward higher percentages of GR-S all the time; however, there is no economical advantage at the present time, considering the cost of the cementing that has to be done. It is difficult to make completely satisfactory light-colored stocks from GR-S. In the event of very high natural rubber prices, the use of GR-S will probably reach about 65%.

9. Q. Since it has been demonstrated that up to 33% can be saved in mixing times with lower peak power requirements, why is there such a reluctance to up-side-down mixing in the Banbury?

A. Winkelmann. If this statement about the saving with up-side-down mixing is really true, there should be no problem or reluctance to adopt the method. Saving in mixing time, however, should not be achieved at the risk of poor dispersion. Up-side-down mixing must be done in a Banbury that does not leak and can take the peak load consistently. Engineers are concerned about the wear and tear on the Banbury resulting from the use of this method of mixing.

A. Kramer. We have had experience with up-side-down mixing at two plants. At both we had to stop the procedure because it was too hard on the Banbury. We found that the peak load was several times the normal peak load. This experience was with stocks with a high loading of SRF black.

10. Q. Is the odor of GR-S a limiting factor in its use in foam rubber sponge?

A. Svendsen. In the past the odor of GR-S has been a limiting factor in the manufacture of bedding items. Odor is a very important factor in the acceptance of rubber mattresses, and careful study was given to the problem, and many tests were run before GR-S was introduced. A better and better job is being done by the GR-S plants in eliminating the odor from GR-S latex.

11. Q. Do GR-S tires show poorer skid characteristics than natural rubber tires?

A. Hendriksen. Natural rubber tires

are better on ice and packed snow; whereas GR-S tires are better on wet pavements. The low-pressure tire has helped improve skid characteristics of both types. The difference, however, is not great between the two types.

Q. Is there enough difference in properties to warrant the large number of GR-S polymers in production?

A. Reznicek. No. We hope to eliminate a number of polymers without sacrificing quality. It is no longer economical to produce certain polymers, particularly certain hot GR-S polymers whose volume is small; and others could be replaced by cold polymers to advantage.

Q. What is the greatest factor contributing to dimensional change in extrusions, variations in the polymer, the loading, the pigment, or the processing?

A. Braden. Processing variations are probably the greatest factor, although polymer variations can be a problem. Another source of difficulty is using the bag weight of pigments instead of weighing out each ingredient. Sometimes trouble can develop from substituting one supplier for another

even though the materials from the two are supposed to be identical.

Q. What type of compounding ingredient of GR-S needs improvement?

A. Hendriksen. As far as tires go, an improvement of tack in GR-S would be an advantage. An improvement in tack is particularly desired in the cord body and the tread splice.

A. Kramer. In footwear, better tack would help in using more GR-S. Another need is a peptizer that would really break down cold GR-S and reduce shrinkage. We also need better reinforcing white fillers.

A. Winkelmann. We would welcome a compounding ingredient which would impart better ozone and weather resistance and also one that would improve hot tear resistance.

A. Svendsen. An accelerator that gives a flat cure to foam rubber is needed. Another ingredient needed is a good light-colored non-staining antioxidant for foam rubber.

A. Braden. A good low-modulus smooth-out carbon black would help in

extrusion work.

A. Reznicek. One ingredient that is needed in the compounding of GR-S is a chemical that inhibits gel formation. If desirable, such a material could be used in the production of GR-S polymers as well.

Q. What is the procedure necessary to obtain a new polymer?

A. Reznicek. First there must be a special problem which requires the production of a new polymer, and the Technical Service Branch, Office of Synthetic Rubber, should be informed fully of the problem and the desired characteristics of a polymer for it, so that it can be determined whether or not there is already available a polymer that has the special properties needed. It is also necessary to know the approximate volume requirements since it is not economical to make a new polymer for small volume items. This information should be furnished to the Technical Service Branch, which will coordinate such information with the Research & Development Division, as it is the responsibility of that division to establish an experimental run if it is deemed desirable.

Rubber & Plastics Division, ASME, Holds Two-Day Meeting in New York

THE Rubber & Plastics Division of the American Society of Mechanical Engineers held an interesting and well-attended two-day meeting at the Hotel Statler, New York, N. Y., December 4 and 5, as part of the annual meeting of the parent Society.

The two half-day technical sessions on December 4 were devoted to papers on the rubber field, and the two half-day technical sessions on December 5 were concerned with plastics. There was also a luncheon-meeting of the executive, advisory, and general committees of the Division on December 5. Glen W. Neely, The Richardson Co., chairman of the Division for 1952, presided at the luncheon meeting and introduced the Division chairman for 1953, M. E. Lerner, *Rubber Age*.

Technical Session 1

Chairman of the first technical session was R. H. Gerke, United States Rubber Co., Passaic, N. J., and vice chairman was G. C. Maassen, R. T. Vanderbilt Co., New York.

"Hypalon" S-2, a Durable, Versatile New Elastomer," was the title of the first paper, by Alfred Stockfleth, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. "Hypalon" S-2, chlorinated polyethylene, is one of the most durable elastomers yet developed and should find wide application in the mechanical goods field, it was said. The basic properties of polyethylene were reviewed, and the effect of adding varying amounts of chlorine and sulfur dioxide to polyethylene were shown in connection with the development of the amounts of these two substances used to produce "Hypalon" S-2. Curing and compounding procedures were explained, and the polymer's outstanding resistance to abrasion, ozone, and excellent weathering properties emphasized. It was also pointed out that the new elastomer was very compatible with other polymers, and the improvements that could be imparted to various other elastomers by blending with "Hypalon" S-2, were stressed.

"Flowed-In Gaskets—Their Properties, Application, and Use," by William M. Rand, Jr., Dewey & Almy Chemical Co., Cambridge, Mass., was the next paper on the program. This paper described how liquid synthetic resin or rubber compound is flowed into a gasket channel and then baked to provide a solid gasket. Examples of the applications of the method to the gaskets used by instrument manufacturers for glass faced dial gages, the gasket used in automobile air cleaners, automobile shock absorbers, etc. were mentioned. Details of the automatic and semi-automatic machines used to produce flowed-in gaskets at speeds in excess of 300 a minute were illustrated and described.

"The Room Temperature Compound Process," by A. N. Gray, Western Electric Co., Baltimore, Md., was the final paper on the first session. It was explained that the wire covering and vulcanizing process involving the continuous, high-speed, vulcanization of the rubber insulating compound installed in the Point Breeze plant in the early 1930's was redesigned in 1945, primarily for the production of the two billion feet of drop wire required annually by the Bell System, but also to improve handling, processing, and quality of the rubber compound and finished wire. The basis of the new process, as indicated by the name, revolved around maintaining the temperature of the compound fed to the wire extruder at a reasonably constant temperature the same as that of the room, thus minimizing wall thickness variation due to variation of rubber compound plasticity with temperature.

The problem of the design of a new extruder screw by which more uniform flow of the compound during wire covering could be obtained was discussed. The thread of the screw at the feed end was gradually changed from deep to shallow at the exit end, and this design provided some mixing of the compound as it progressed through the machine. Very much improved quality of the finished wire, as measured by voltage breakdown tests, was achieved.

Technical Session 2

Chairman for the second session on rubber was Fred Conover, Raybestos-Manhattan, Inc., Passaic, and vice chairman was John Carnish, of the same company.

"Measurement of Tread Wear of Commercial Tires," by Robert D. Stiebler, G. G. Richey, and John Mandel, National Bureau of Standards, Washington, D. C., was the first paper of the second session. Studies at NBS have resulted in a marked improvement in the precision and reliability of measurements of tread wear. A comparison made of the weight and depth-of-groove methods for determining tread wear in three road tests recently conducted was explained. It was emphasized that the weight method is useful for accurate determination of tread wear after the tires have been run for only a relatively small number of miles; while the depth-of-groove method is not.

The tread wear tests were designed so that the effect of wheel position was minimized. Statistical analysis of the results showing the coefficient of variation between the two methods was reported. It was concluded that the weight methods of determining tread wear was more satisfactory, and that in the design of the test it was important to compensate for as many known variables as possible. The geometric average was recommended for all calculations.

"Creep of Neoprene in Shear under Static Conditions—Ten Years" was the title of the next paper by W. Newlin Keen, du Pont. The author had presented a paper before the ASME in 1945 on the results of static creep tests conducted at room temperature over a period of three years and nine months. The present paper presents the results of tests obtained over a period of nearly eleven years, and the study has been extended to include the effect of changes in test temperature.

The data clearly indicate that neoprene vulcanizates can be designed to have resistance to creep equal to or better than that of natural rubber. One neoprene compound showed outstanding performance over a range of temperatures. The value

of this information to the design and application engineer was pointed out.

"Engineering Developments of Rubber, 1951-1952," by Leora Straka, Good-year Tire & Rubber Co., and Betty Jo Clinebell, University of Akron, both of Akron, O., was presented by B. S. Garvey, Jr., Sharples Chemicals, Inc., Wayne, Pa., and chairman of the Library Committee, Division of Rubber Chemistry, A. C. S. This paper is the annual survey of developments in rubber from July, 1951, to June, 1952, which are of interest to the mechanical engineer. New types of rubber, new uses of rubber, and their development are discussed. A review of the economic situation in connection with the use of natural and synthetic rubber during this period was included.

Technical Session 3

Chairman for the first plastics session was James M. Church, Columbia University, New York, and vice chairman was Bryce Maxwell, Princeton University, Princeton, N. J.

"A Comparison of Solid and Laminated Transparent Acrylic Enclosures for Aircraft," by Gordan M. Kline and Benjamin M. Axilrod, both of NBS, was the first paper of this session. A survey of data from two material suppliers and an aircraft manufacturing company in which equal thickness of the solid and the laminated types of glazing could be compared for several properties of the materials was reported.

The laminated material showed greater shatter resistance under pressure to bullet impact. Stress crazing of the solid material resulted in a 30 to 50% drop in strength, and crazing was also more prevalent in the laminated material because of the plasticizer in the interlayer.

The latest work at the Bureau of Standards indicates that biaxial stressing of the acrylic plastic increased craze resistance materially by converting the solid amorphous plastic to a laminar-type material. Shatter resistance is also improved.

"Stress Crazing of Plastics," by J. A. Sauer and C. C. Hsiao, Pennsylvania State College, State College, Pa., was the next paper on the program. The effect of various factors on the inception and growth of crazing was reviewed, and some of the similarities between crazing in plastics, exposure cracking in rubber, and stress cracking in rubber, and stress cracking in metals were described.

Various examples of stress crazing in transparent plastics were presented, and the stress-strain behavior was reported for crazed, non-crazed, and oriented material. Rate of propagation of crazing was also investigated. The test results indicated that penetration of crazing cracks in polystyrene can be represented over a limited stress range by a linear function of both time and stress magnitude. Some measures advocated for avoiding the undesirable effects of crazing include use of special coatings, annealing, and establishment of working stresses based on onset of crazing rather than on static fracture.

"Some Design Considerations for Injection Molding Heating Chambers," by G. D. Gilmore and G. B. Thaver, Dow Chemical Co., Midland, Mich., was the third and last paper on the third technical session program. The general design of injection molding heating chambers has been well established after gradual development through several years of experience. In this paper some of the details of design directly concerned with the plastic material

characteristics (polystyrene) were examined to a limited extent.

Heat transfer and pressure losses in the heating chamber are interrelated, and the geometry of the passages through which the plastic moves can be arranged for optimum heat transfer rate with minimum pressure loss, it was said. Recommendations in this connection included increasing the heater body bore, increasing the heating zone length and decreasing the section thickness, the use of an internal heater in the spreader, special attention to the design and operating features of the cold zone. Machine specifications for a 14-ounce machine to incorporate the above recommendations were given.

Technical Session 4

Chairman for the final technical session on plastics was H. F. Wakefield, Bakelite Corp., and vice chairman was Ray Platow, U. S. Plywood Corp., both of New York.

"Effect of Defects on Strength of Aircraft-Type Sandwich Panels," by A. A. Mohaupt and B. G. Heebink, Forest Products Laboratory, United States Department of Agriculture, Madison, Wis., was the first paper of the fourth session. The paper reported studies conducted to determine the effect of several specific types of defects on the strength properties of a limited number of typical aircraft sandwich constructions.

Poor bonds in sandwich constructions of aluminum facings on balsa core and of glass-cloth facings on balsa core reduced the flatwise tensile strength considerably more than they reduced the bending and edgewise compressive strengths. Unbonded areas from one inch to three inches in diameter caused substantial reductions in the edgewise compressive strength of specimens six inches wide.

Wrinkles in the glass-cloth facings of specimens having balsa or glass-cloth honeycomb cores, reduced the bending, edgewise compressive, and longitudinal tensile values by amounts in proportion to the depth of the wrinkles. No appreciable effect was produced on the bending and longitudinal tensile strengths by increasing the number of plies in the facings of similar specimens gradually or abruptly from five to ten. Butt joints in glass-cloth facings resulted in no effect on the edgewise compressive strengths, but reductions were evident in the bending and longitudinal ten-

sile strengths. A fold in the glass-cloth facing caused considerable reductions in bending, edgewise compression, and longitudinal tension, it was said.

"The Effective Control of Lead Dust in the Manufacture of Vinyl Plastics," by Alexander E. Goss, Connecticut State Department of Health, Hartford, Conn., and Arthur M. Ross, Jr., Ross & Roberts Co., Stratford, Conn., was the next paper on the program. In the manufacture of plasticized polyvinyl chloride products, the use of powdered lead compounds creates a definite health hazard that has been difficult to control effectively, it was pointed out.

A new method of manufacture whereby these lead compounds, as well as other powdered stabilizers, colors, or pigments, are (1) transferred from their original containers in an exhausted enclosure, and (2) either processed into non-dusty forms, or (3) weighed into plastic bags and sealed before entering the factory proper, provides the basis of maximum control of the dust hazard with a minimum of exhaust ventilation.

This innovation in the manufacture of vinyl plastics products in a plant producing calendered and extruded polyvinyl chloride film resulted in inhalation concentrations of lead in the workroom atmosphere well below the maximum allowable concentration as defined by the state regulations. The concentration of lead in the urine of the exposed workers was within or near the range of individuals not exposed to lead dust, it was added.

"Selected Plastics References for the Mechanical Engineer—July, 1951—June, 1952," by Helen G. Dikeman and A. K. Schmeider, Monsanto Chemical Co., Springfield, Mass., completed the program. This brief review was designed to draw attention to those currently reported developments in the plastics industry judged to be of interest to mechanical engineers. The bibliography includes recent, specific developments and reviews which serve as a guide to a restricted field and its literature and were included under the headings of materials, properties, fabrication techniques and applications.

Committee Meeting

At a luncheon meeting of the executive, advisory, and general committees of the Division on December 5, the elections of Mr. Lerner, as chairman for the year 1953, and of A. G. Gifford, Lord Mfg. Co., Erie, Pa., as secretary were announced. It was also reported that E. F. Riesing, Inland Division, General Motors Corp., Dayton, O. would be chairman of the rubber papers committee, replacing E. N. Cunningham, Precision Rubber Products, also of Dayton.

Mr. Lerner described briefly the plans for the Division for 1953, including the meeting at Columbus, O. April 28-30, which will consist of at least three technical sessions, one in the form of a symposium on industrial rubber molded goods. Four half-day technical sessions are scheduled for the meeting in New York about December 1, 1953.



Allied News Photo—Shelburne

M. E. Lerner

L. F. Hickernell, chief engineer, Anaconda Wire & Cable Co., Hastings-on-Hudson, N. Y., has been elected a director of the American Institute of Electrical Engineers, for a term extending from January 1, 1953, through July, 1954.

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Extrusion Variables

A TALK on "A Laboratory Examination of Some Extrusion Variables" by E. B. Storey, Polymer Corp., Ltd., highlighted the November 13 dinner-meeting of the Ontario Rubber Section, C.I.C. Approximately 45 members and guests attended the meeting, held at Muirheads Restaurant, Kitchener, Ont., Canada.

Mr. Storey noted that the divergent fields of application of specific elastomers makes it difficult to obtain a comprehensive correlation between their extrusion characteristics and their chemical and physical properties. A laboratory program was undertaken to provide such a correlation. The effects of die length and diameter, and worm speed were determined for circular dies, using a $\frac{1}{2}$ -inch extruder and masterbatches of 50 parts EPC black with various elastomers. The volume rate of extrusion of the masterbatch was shown to be proportional to the pressure developed in the extruder head. Spring devices were described by which the pressure could be measured at the entry to the die tube and, by means of die extension tubes, at any point along the tube. The pressure drop through the die tube was linear and varied directly as the ratio of the length to the diameter of the tube. The volume rate-pressure relation was characteristic of the specific elastomeric masterbatch.

The phenomenon of die swell was related to a velocity gradient found to exist across the die tube section. Experiments showed that die swell was not affected by the type of metal used for the die. This effect could be explained, Mr. Storey said, by assuming that there was a small but finite velocity of the masterbatch at the die tube wall. An increase in the worm speed or in the die tube ratio of length to diameter resulted in an increase in the velocity gradient and, hence, the die swell.

Temperature of the extruded material and its scorch characteristics were found to be directly related to the worm speed, but were not affected to any great extent by die dimensions. The constants of an exponential flow equation relating the shear stress and rate of shear during extrusion can be evaluated by means of the die extension tubes and spring devices. This flow equation gives a mathematical description of the processing properties of an elastomer, Mr. Storey stated.

ers, oil resistance of nitrile rubber blends, and the effects of ASTM oils on swelling of nitrile rubbers. Mr. Bascom concluded the series of talks with a display and discussion of parts made from nitrile rubber and latex, including aircraft fuel seals, oil rings, oil containers, aerosol bomb seals, hose, and other products.

will start teaching a course in "New Developments in Rubber Chemistry and Technology," as well as direct the laboratory work whose results will be made available to the rubber industry, it was said.

Gidley Institute Contest

THE Gidley Research Institute, Fairhaven, Mass., has announced that it will conduct a Rubber Technical Prize Paper Contest in an attempt to obtain material for publication on the practical aspects of rubber compounding and processing. According to Philip T. Gidley, president of the Institute, there is need of a wider base of participation in oral and written material regarding the rubber industry by many technical men, factory foreman, plant chemists and engineers, etc.

The articles to be prepared must be not less than 500 words and not more than 5000 words. Photographs, graphs and blueprints may be included but are not necessary. Any subject in the field of industrial rubber manufacturing technology may be covered. The subject of the article and its content, however, must be practical and technical rather than theoretical only. Typical acceptable subjects would be: "Causes and Elimination of Porosity in Three-Roll Calendering," or "Practical Considerations in Mold Design," or "A Factory Scheduling System for the Press Room," or "A Study of the Efficiency of Mold Lubricants for Vacuum Cups."

The first prize will be \$200 in cash, and nine additional merchandise prizes will be awarded. The contest is not open to members of the staff of the Gidley Research Institute. All articles become the exclusive property of the Institute. The most meritorious articles will be published.

All articles should be addressed to the Rubber Technical Prize Paper Contest, Gidley Research Institute, Fairhaven, Mass.

Rubber Ordnance List

THE Ordnance Corps, Department of the Army, is preparing a list of rubber suppliers and their compounds which meet the requirements of the SB, SC, and RS grades of specification MIL-R-3065 (similar to ASTM D735-51T). There is particular interest in the 500-, 1,000-, 1,500-, and 2,000-psi. tensile grades in the durometer hardness range of 40-70. Suffix combinations may include A, B, C, and FF; the FF test requirement is non-failure after 24 hours' conditioning at -65°F , using the impact brittleness test of ASTM D746. Interested suppliers of such rubber compositions are invited to submit their samples or address their inquiries to the Rubber Laboratory, Rock Island Arsenal, Rock Island, Ill.

Speak on Nitrile Rubber

THREE talks on nitrile rubber by speakers from B. F. Goodrich Chemical Co. featured the November 19 meeting of the Washington Rubber Group. Some 100 members and guests attended the meeting held in the Pepco Auditorium, Washington, D. C. The speakers and their subjects were: "History of Nitrile Rubbers," Waldo L. Semon; "Oil Resistance of Nitrile Rubbers," N. G. Duke; and "Nitrile Rubber and Latex Applications," R. C. Bascom.

Dr. Semon outlined the history of the nitrile rubbers, beginning with the work done by Ziegler at I. G. Farben in the late 1920's. Goodrich's work on the analysis of German Buna N enabled it to produce its own rubber, Hycar, and start the nucleus of the nitrile rubber industry in this country. Mr. Duke discussed the oil resistance of nitrile rubbers, including the effect of pigmentation, effect of softening



Harris & Ewing

Harry L. Fisher

Discuss Use of Patents

THE Fort Wayne Rubber & Plastics Group held its last dinner-meeting of the year on December 4 at the Van Orman Hotel, Fort Wayne, Ind. Featured speaker was Theodore A. TeGrotenhuis, Evans &

McCoy, who discussed, "The Use of Patents in Research and Development." Prior to the dinner there was a showing of the Natural Rubber Bureau film, "Stretching Highway Dollars with Rubber Roads."

Mr. TeGrotenhuis reviewed the history of patents and discussed the use of patents to stimulate the promotion of ideas, requirements for inventions, the protection of inventions, and recent changes in the patent laws. It was pointed out that all countries considered progressive have patent systems.

Groups' Christmas Fêtes

Record Crowd for Boston

A RECORD total of 600 members attended the annual Christmas party of the Boston Rubber Group, held December 18 at the Somerset Hotel, Boston, Mass. The program included a cocktail hour, dinner, entertainment in the form of vaudeville acts, and the distribution of some 250 door prizes. R. K. Patrick, Vulplex, Inc., was chairman of the entertainment committee.

New Group officers for the coming year were announced by R. B. Huber, R. B. Huber Co., chairman of the elections committee, as follows: chairman, Alan W. Bryant, Binney & Smith Co.; vice chairman, W. Fraser Malcolm, Titanium Pigments Corp.; secretary-treasurer, Edwin D. Covell, Stedfast Rubber Co.; and executive committee, two-year term, Arthur I. Ross, American Biltite Rubber Co.

Successful Affair at New York

A VERY good crowd of about 500 members and guests were present at the Henry Hudson Hotel, New York, N. Y., December 12, for the annual Christmas party of the New York Rubber Group.

The usual cocktail hour preceded dinner, following which those in attendance were entertained by some fine variety acts. Retiring Chairman J. S. Corrigall, R. T. Vanderbilt Co., introduced the new chairman, George N. Vacca, Bell Telephone Laboratories, and other new officers and directors of the Group during dinner. A complete list of the new officers and directors appears in our November issue on page 284.

The evening was concluded with the drawing for 116 prizes made possible by contributions from numerous suppliers to the industry, and others.

Ladies Night at Chicago

A CAPACITY crowd of 850 members and their guests filled the Terrace Casino of the Morrison Hotel, Chicago, Ill., for the annual Christmas party and Ladies' Night of the Chicago Rubber Group on December 19. The program included a cocktail hour, dinner, entertainment in the form of night-club acts, and an evening of dancing. Each lady in attendance was presented with a favor in the form of a handsome evening bag, with the compliments of the Group. The committee in charge of arrangements expressed their appreciation to the more than 150 rubber and supplier companies whose contributions made the party possible. Howard Ling, Naugatuck Chemical Division, United States Rubber Co., was chairman of the committee which included Dick Blair, Columbia-Southern Chemical Co.; Larry Heide,

Acadia Synthetic Products Division, Western Felt Works; Steve Lillis, Victor Mfg. & Gasket Co.; John O'Keefe, *Rubber Age*; John Swart, Van Cleef Bros., Division of Johns-Manville Corp.; and Ben Yunker, Sirvenc Division, Chicago Rawhide Mfg. Co.

Buffalo Announces New Officers

THE Buffalo Rubber Group held its annual Christmas party on December 17 at the Buffalo Athletic Club, Buffalo, N. Y. Some 145 members and guests attended the party, which consisted of a cocktail hour, dinner, vaudeville entertainment program, and a drawing for numerous door prizes contributed by rubber and supplier companies.

Results of the annual election of officers and executive committee members were announced, as follows: chairman, Russ Schutz, U. S. Rubber Reclaiming Co.; vice chairman, Glenn Meyers, James Meyers Co.; secretary-treasurer, Gene Cimelli, U. S. Rubber Reclaiming; and executive committee, (three years) Don E. Schuler, Dunlop Tire & Rubber Co., and Frank Niemczyk, Buffalo Weaving & Belting Co., (two years) Ed Martin, Hewitt-Robins, Inc., and Neil Peffer, Buffalo Weaving, and (one year) Jean H. Nesbit, U. S. Rubber Reclaiming, and Charles E. Johnson, Hewitt.

the courtesy of Koppers Co., Inc., and R. C. Molding, and the party ended with a drawing for 70 odor prizes contributed by molding, tool making, and supplier companies.

New Lustrex Nomenclature

A REVISED system of nomenclature for its Lustrex styrene molding compounds has been announced by Monsanto Chemical Co., Springfield, Mass., through David Guaraccia, sales manager for thermoplastics. Under the new system, code letters and numbers are used to designate grade of material (general purpose, heat resistant, etc.), light transmission range (opaque, translucent, etc.), color (both basic hue and shade), and formulation.

As part of the new system, Lustrex LHN, a new improved high impact styrene, replaces Lustrex LT; Lustrex LH, medium impact styrene, becomes Lustrex LHA; and heat resistant Cerox 250 becomes Lustrex LXC. Complete information on the new nomenclature system is given in the company's revised technical service bulletin TPM-12.

Reinsmith and Maassen ASTM District Speakers

THE December 8 meeting of the New York District of the American Society for Testing Materials held at the Engineering Societies Building, New York, N. Y., was featured by talks by Gerald Reinsmith, Office of Chief of Ordnance, Department of the Army, and G. C. Maassen, R. T. Vanderbilt Co. Chairman for this meeting was Sherman R. Doner, Raybestos-Manhattan, Inc.

Mr. Reinsmith, chief of the non-metals structural materials unit of the Army Ordnance Corps, discussed "Army Ordnance Rubber Goods," and included in this talk a brief outline of the organization of the Department of Defense with special reference to the Army Ordnance Corps relative to its mission and how it is organized to develop and procure military rubber goods. A discussion on rubber goods used by the Ordnance Corps and a short review of the current rubber development and research program of the Corps concluded this talk. Most of the information in the latter part of Reinsmith's talk appeared in our May, 1952, issue.¹

Mr. Maassen, who has been active on several subcommittees of ASTM Committee D-11 on Rubber for several years and has been chairman of subcommittee 15 on life aging since 1948, gave an interesting talk on the work of the D-11 Committee.

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New York Party

(Continued from page 520)

pair of binoculars on behalf of the members and directors.

Table favors were distributed through

Glass Mat Specification

A NEW military specification, MIL-M-15617A, that replaces several specifications used by various military activities for fibrous glass mats for reinforcing plastic materials has been issued by the Defense Supply Management Agency. By combining and consolidating previous requirements into one specification, applications of the reinforced plastics are expected to be accelerated. The fibrous glass plastics made with polyester and other resins are being used for boats, field transit cases, water and fuel tanks, floats, recording tape reels, loudspeakers, rotary electrical switches, radomes, antenna housings, snow sleds, and other applications still under development.

Start Vinyl Monomer Production

Monsanto Chemical Co., St. Louis, Mo., last month announced that its Texas division plant at Texas City has begun production and regular shipments of vinyl chloride monomer. According to R. U. Haslanger, sales manager, the monomer is made from acetylene, hydrochloric acid, ethylene, and chlorine, and is being shipped in tank cars and pressure cylinders. Ethylene dichloride is produced as an intermediate in the process. The productive capacity of the plant will be great enough to permit marketing of ethylene dichloride as well as the vinyl monomer, Haslanger said. A portion of the Texas City production is going to the company's plastics division plants at Springfield, Mass., and Port Plastics, O., where it is converted to vinyl chloride and copolymer resins.

Production of vinyl monomer is the second step of a three-way expansion at Texas City; the first step was completed last July when shipments of styrene monomer were begun.

NEWS of the MONTH

The annual report of the Reconstruction Finance Corp. for the 12 months ended June 30, 1952, showed that the agency's net profit on sales of synthetic rubber for that period totaled \$16,113,542. The amount of these sales was \$415,932,537. Expansion of GR-S capacity to 860,000 long tons a year will be completed by January 1, 1953. Oil-masterbatched GR-S has become an established production item; Alfin type GR-S is being evaluated in tire treads, and Nitrazole CF-type GR-S holds much promise, RFC said.

RFC ordered two more alcohol butadiene lines reactivated to meet the soaring demand for GR-S which began in October. First-quarter 1953 production of GR-S should reach 175,000 long tons. Industry estimates for GR-S first-quarter consumption, set at 163,373 tons on September 30, have been revised upward.

Plans for disposal of the government synthetic rubber plants are progressing, but are awaiting the engineering ap-

praisal of the plants expected by January 15. Some interesting information of the procedure of writing off the value of the RFC synthetic rubber plants has been revealed. RFC is placing more weight on the replacement value of these plants, and the industry is determined that book value should be used.

The quantity tire discount rule of the Federal Trade Commission is still not in effect although the tire company motion to declare the rule invalid was denied by Judge McGuire in Federal District Court in Washington on November 26. An appeal is expected.

The Rubber Manufacturers Association, Inc., in its year-end report, predicted a new all-time consumption record for rubber in 1953. It also pointed out that 1953 is the "year of decision" for getting the synthetic rubber plants into private hands and said it expects the transfer to be an accomplished fact by March 31, 1954, the termination date of the Rubber Act of 1948. Improved

volume of business for all branches of the industry is looked for in 1953.

Leading industry executives expressed similar optimism for 1953, and the sale of rubber chemicals and resins is also considered to continue to higher levels than in 1952.

E. J. Thomas, president of Goodyear Tire & Rubber Co., emphasized that the future beyond 1953 is not all rosy unless America expands its synthetic rubber producing facilities.

The non-tire outlook was also called bright, as was the outlook for the plastics industry. Under certain conditions 1953 might be a record year for the plastics industry, it was said.

Intense competition in the chemical industry in 1953 was predicted by J. R. Hoover, president of the B. F. Goodrich Chemical Co. He stated that this competition would result from the ample supply of most chemicals relative to demand by virtue of the plant expansion programs that have been completed recently.

Washington Report by Arthur J. Kraft

RFC Annual Report Discusses Expansion and Research

In its annual report and financial statement, issued December 21, RFC reported that its sales of synthetic rubber in the year ended June 30, 1952, totaled \$415,932,537, and the agency turned in a net profit on these sales of \$16,113,542. During the year RFC produced 799,266 long tons of synthetic rubber, including 715,732 tons of GR-S and 83,534 tons of butyl, or 65.2% of domestic new rubber consumption of 1,227,000 tons. The agency also produced 580,700 short tons of butadiene and 52,700 tons of styrene. Production of synthetic rubber in fiscal 1952 was only slightly below the 760,000-ton annual rate reached at the end of fiscal 1951 (June 30, 1951). In the first six months of 1952, production was dropped to an annual rate of 685,000 long tons, and plans were made for further reductions during the current fiscal year (July 1, 1952, to June 30, 1953). The plans for further cutbacks in fiscal 1953, made in the expectation of a lower demand for rubber, were to have involved the removal of remaining alcohol butadiene facilities from service and the release of certain quantities of petroleum butadiene plant feedstocks to the aviation gasoline program, the RFC report states.

[The plans for further cutbacks have been dropped, as in fact had certain of the steps taken toward that goal been reversed in recent weeks, owing to the sudden resurgence of industrial demand for new rubber which became apparent in October.]

Other highlights of the RFC report are discussed below.

Plant Expansion

Expansion of GR-S capacity to 860,000 tons a year "will be essentially completed by January 1, 1953."

Projects expected to be completed by January 1, 1953, will make possible production of 75% of total GR-S in the form of cold rubber. Cold rubber latex accounted for 5% of all GR-S latex produced in July,

1951, and was boosted to 25% of the total a year later. A further increase came when one of the Akron plants was converted exclusively to cold rubber latex.

Expansion of butyl capacity at Baytown, Tex., was completed during fiscal 1952, and expansion at the Baton Rouge, La., plant will be completed in the current fiscal year.

A plant-scale experimental run of a new butylene dehydrogenation catalyst was conducted at the Baytown butadiene plant and "was successful in determining the engineering and technical data required to evaluate the feasibility and economics of utilizing this catalyst at the other petroleum plants." This catalyst is "potentially important" because of indications that it makes for more efficient use of butylene in producing butadiene.

The Torrance, Calif., styrene plant was expanded to produce 57,000 short tons of styrene, still not enough to satisfy the needs of the rubber program.

Research Activities

During the year, research and development were conducted for RFC by eight industrial organizations operating GR-S plants, at government laboratories operated by the University of Akron, by a Government Tire Test Fleet at San Antonio, Tex., by the National Bureau of Standards, and by 11 universities, institutes, and other research organizations.

The following were highlighted in the report as among the most noteworthy accomplishments of the research program:

"1. Oil-masterbatched GR-S was developed to the point where it has become an established production item because of demonstrated improvement in tread wear performance over cold GR-S at a substantial reduction in tire cost." This product also provides an expansion in apparent rubber supply with a minimum of expenditure of raw materials and equipment."

[The report notes that acceptance of

high Mooney oil-softened GR-S requires "extensive and time-consuming evaluation by the rubber industry" and pointed out that the gradual acceptance of oil masterbatch rubber by industry is supported by figures showing an increase in production from about 2% of total rubber production to about 6% over the 12-month period ending last June 30. "The trend of acceptance of oil-black masterbatch is not as definite, however, and a longer period of evaluation by industry will probably be required. The production of black masterbatch rubbers experienced relatively small change over the previous year. However, in order to improve the rubber distribution pattern, facilities were authorized for producing black masterbatch rubber in the West Coast plant, and installation was essentially completed by the end of the year (June 30, 1952)."]

"2. A process using a so-called 'Alfin' catalyst was developed and successfully carried out on a continuous pilot-plant scale in the Government laboratories. Substantial quantities of high molecular weight Alfin polymers were prepared for evaluation in tires and other essential products. Alfin polymers are extremely tough and yet are free from the degradation constituent known as 'gel.'

"3. A type of GR-S approaching cold rubber in physical properties, but which can be produced in non-refrigerated equipment was developed. Tests of the new synthetic on the Government fleet totaling 600,000 tire miles, together with results reported on private tests, lead to the conclusion that it is definitely better for tread wear than hot rubber, and possibly equal to cold rubber. This development increases the productive flexibility of the Government-owned synthetic plants, because if full consumer acceptance of the new product is obtained on such matters as processability, the hot rubber capacity of the plants can be directed to the manufacture of an improved product. It is possible that further research and development may enable the new type of polymerization to be utilized for the production of synthetic

rubber in cold rubber plant equipment so that a product even better than the present cold rubber may be eventually realized.

"The results of research from all participants in the program are published as rapidly as they can be technically edited. During the past year, 94 articles were published in scientific or technical journals.

"RFC formulates the over-all research program each year and with the aid of inter-related committees develops detailed plans, maintains a balance among the fundamental, applied, and developmental research work and facilitates a continuous exchange of research findings. The general objectives are to make synthetic rubber better and cheaper, and to produce it more efficiently."

Capital Improvements

"During the fiscal year 1952 capital expenditures amounted to \$21,605,000 as compared to \$12,560,000 in the fiscal year 1951. These expenditures were for costs of (a) expansion of productive capacity; (b) conversion to cold rubber capacity; (c) process and other improvements; and (d) replacement of worn-out and obsolete equipment. The program for conversion to cold rubber upon completion will have cost approximately \$12,000,000."

Statement of Operations

"Net income for fiscal year 1952 amounted to \$16,113,542. This profit was attained despite curtailment of production in the latter part of the year when the demand was lower than the anticipated demand, in expectation of which production in the earlier part of the year had been increased by use of the more costly alcohol butadiene in the manufacture of GR-S rubber. Due to labor difficulties in the petroleum industry, high-cost alcohol butadiene was also used in the limited production for May, 1952. Also, \$3,000,000 was provided to cover costs of shutting down excess production facilities, and the inventory of alcohol on hand at the end of the year was written down by approximately \$5,000,000 to estimated market value.

"As a consequence of a demand for synthetic rubber lower than the production levels to which the Corporation had been directed to expand the capacity of its facilities, inventories of both GR-S and GR-I increased during the course of the year. Inventories of GR-S increased from

29,000 long tons valued at \$10,926,000 at the beginning of the fiscal year to 72,000 long tons valued at \$27,889,000 at the close of the year. Inventories of GR-I increased from 3,600 long tons at a cost of \$1,352,000 on hand at the beginning of the year to 15,000 long tons at a cost of \$5,080,000 accumulated by the end of the year.

"A financial statement presenting a summary of operations of the synthetic rubber program follows:

RECONSTRUCTION FINANCE CORP.
STATEMENT OF OPERATIONS OF SYNTHETIC
RUBBER PROGRAM
FISCAL YEAR ENDED JUNE 30, 1952

Income:	
Sales of synthetic rubber.....	\$415,032,537
Revenue from tank car operations.....	181,525
Other income.....	444,107
	\$419,558,169
Operating Costs and Expenses:	
Cost of rubber sold:	
Cost of production:	
Cost of materials consumed.....	\$291,054,410
Processing costs.....	60,709,790
	391,824,200
Inventory of finished rubber at beginning of period.....	12,278,086
	364,102,286
Less:	
Inventory of finished rubber at end of period.....	32,969,068
Finished rubber consumed in research.....	8,513
	331,124,705
Cost of rubber sold.....	
Depreciation of operating plants and facilities (including \$827,030 on leased facilities).....	40,635,392
Research and development.....	6,939,476
Adjustment of raw material inventories at June 30, 1952, to the lower of cost or market—(Note 1).....	5,023,513
Storage and handling of finished goods.....	930,894
Administrative expense.....	2,391,765
Losses from fire and other casualties.....	1,383,451
Other expenses and losses.....	740,923
	389,170,119
Net income from operations.....	27,388,050
Interest on U. S. Government Funds Invested in Net Operating Assets Provisions for Shutdown Expense—(Note 2).....	5,305,646
Reactivation Expense.....	3,000,000
Expenses for Maintenance and Protection of Standby Plants and Facilities (includes \$850,123 depreciation on standby plants).....	1,982,158
	986,704
Net Profit.....	\$16,113,542

Note 1: The cost of inventories of alcohol and other raw materials held for use in the production of synthetic rubber at June 30, 1952, exceeds by \$5,023,513 a valuation based on the lower of cost or market. This decline in value has been charged to synthetic rubber operations for fiscal year 1952.

Note 2: In anticipation of a cutback in production, the sum of \$3,000,000 has been provided for shutdown costs of facilities operated in 1952, which will be taken out of operation in 1953."

Synthetic Rubber Production Increase Planned

RFC took steps in December toward boosting production of synthetic rubber (GR-S) nearly 20% in order to meet increased demand from industrial users. The increase, which should see a production of about 175,000 long tons in the first quarter of 1953, was ordered by RFC Administrator Harry McDonald "as a result of advice from the rubber industry that requirements have grown beyond levels previously contemplated and that there will be a continuing need for more new rubber throughout 1953."

This advice was given at a meeting of the rubber industry advisory committee with RFC December 10. Following the meeting, RFC ordered the reactivation of two alcohol butadiene lines at the Louisville, Ky., plant. This action comes on top of a similar order, issued a month earlier, to reactivate two lines at the

Kobuta alcohol butadiene plant. Both plants were ordered put into standby about September 1 "on the basis of industry estimates for which the production of petroleum-based synthetic rubber facilities would have been adequate," according to RFC's statement of December 10.

The turnaround in demand is illustrated by the following RFC figures. In the third quarter of 1952, RFC sales of GR-S totaled 153,781 tons. Early industry estimates put fourth-quarter demand at 152,144 tons, but it became evident by early October that demand actually would be higher as November orders, coming on top of record October consumption of GR-S, pointed to a fourth-quarter demand of 158,000 tons, or so RFC said in a press release on November 11. At the same time it issued industry forecasts of a first-quarter demand for 163,373 tons,

based on estimates made September 30. The December 10 meeting with the industry indicated an even higher demand, although no figure was disclosed.

In addition to the six-month demand forecast presented by industry to RFC on September 30, the agency also had the benefit of estimates made by the National Production Authority's rubber division, and by RFC itself. The latter two estimates, according to RFC officials, pointed to a higher demand than estimated by the industry. RFC geared its plans, however, to the industry forecast in line with a guiding principle of its program, which is to produce the quantities industry wants to consume, a principle which was translated into a directive from the Defense Production Administration last April, when consumption controls were revoked. The industry estimates of September 30, as noted above, subsequently were moved upward by the industry at the December 10 meeting with the agency.

With production reduced in the fourth quarter by a shortage of petroleum butadiene and the mothballing of the alcohol butadiene plants, RFC found its inventories of GR-S dropping steadily under the impact of industrial demand. Stocks at the end of December were down to about 25,000 tons—approximately the difference between fourth-quarter output and sales. RFC Rubber Director E. Dorrance Kelly acknowledged that this stock level was very low, but expressed confidence that RFC could get through the quarter successfully meeting industry needs. There might be temporary shortages here and there of certain types of GR-S, but no general shortage, he said.

To weather the worst period of the shortage—the period before the alcohol butadiene plants could get back into production—the rubber division carefully screened all industry requests for rubber, keeping allotments to the level which consumers normally took in the past. In October, when the fact that rubber demand was well over RFC's ability to produce sank in, the agency received requests from some rubber firms for two and three times the GR-S these companies used in the past. It turned down applications for these "supplemental" and obviously excessive amounts of GR-S.

Here is how the picture shapes up for achieving the planned expansion in GR-S output: The Kobuta plant will be back in production in January, with one line expected to be producing by late December, and the other two or three weeks later. This operation will add 5,500 tons a month to GR-S output. The Louisville facility will come in later, with one line in production in late January or early February, and the other probably not before March. These two lines also will add 5,500 tons. The four alcohol butadiene lines, when in production will make possible an increase of 11,000 tons a month in GR-S output, or 33,000 tons a quarter. By mid-March, when all lines are operating, RFC will be producing at a quarterly rate of 185,000 tons. First-quarter output will total 175,000 tons. Some of this increase will be made possible by increased supplies of petroleum butadiene. RFC has managed to come up with some additional petroleum butadiene, possibly from private sources. In addition, RFC will be getting some repayment for petroleum butadiene "loaned" by the agency a few months ago to the aviation gasoline program.

A sidelight on the situation is that RFC estimates that the miscalculation of demand, which brought about deactivation of the alcohol butadiene plants and then

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the abrupt turnabout requiring their reactivation, will cost more than \$1 million. Reactivation will cost \$800,000. It will take some time to calculate how much it cost to deactivate the plants, a task interrupted short of completion when the order came to reopen the plants.

How long the alcohol butadiene lines will be kept operating is not known. RFC has the alcohol under contract to run two lines for six months. The agency announced that it will soon seek competitive bid offers for alcohol "to provide additional alcohol for the butadiene plants." The Kobuta plant is operated for RFC by Koppers Co., and the Louisville plant by Union Carbide & Carbon Corp.

Synthetic Plant Disposal Progress

RFC Administrator McDonald told a news conference on December 18 that his agency is making "very good progress" in formulating recommendations covering disposal of the synthetic rubber plants to private industry.

The RFC chief said, however, "I am not predicting how successful we will be."

He pointed out that the work on the engineering appraisal of the plants, being done by the Ralph Parsons Co., Los Angeles, Calif., under RFC contract, is coming along and should be finished about January 15. RFC's report on disposal will be submitted to the President by March 1.

The job of formulating the disposal program apparently is going forward without much formal consultation between RFC and industry. There have been two meetings between RFC Deputy Administrator Morton Yohalem and the rubber industry advisory committee on disposal. The consensus is that the real work must await completion of the appraisal report, since there seems little agreement otherwise between the rubber companies and RFC on the proper value of the facilities. No further meeting was scheduled in late December.

The main burden of drawing up disposal recommendations will fall on RFC and its rubber advisers, although Yohalem reports that he intends sooner or later to confer with members of the petroleum and chemical industry on disposal.

RFC's comptroller early in December told a reporter that the current book value of the synthetic rubber facilities is \$278 million, based on 1942 costs and dollar value. The plants cost \$63 million to build, and \$15 million in improvements have been made. At the present rate of demand for synthetic rubber, RFC could write off the \$278 million book value by 1957, the official said.

RFC operated its synthetic rubber facilities at a loss totaling \$195 million through mid-1947. This loss includes \$112 million dropped on sales of several plants by the War Assets Administration in 1947. The plants cost \$165 million to build and were sold by WAA for \$57 million. RFC made profits in 1947 and 1948 and incurred operating losses in 1949 and 1950. Last year the agency turned in a profit of \$16 million (see RFC financial report elsewhere in this issue). The net profit for the eight fiscal years 1947-52, was \$8 million.

RFC has written off in depreciation \$338 million of the \$508-million investment it had left after WAA sold several of the plants in 1947. This would leave only \$170 million or so (RFC carries \$173 million as the figure) to write off, since Congress authorized the agency to forget

about depreciating the losses incurred on sale of the surplus plants in 1947. However RFC is depreciating that \$112 million loss too. After deducting \$8 million in operating profits earned over the past eight years from the \$112 million, the losses remain at \$104 million. Added to \$173 million in current plant yet to be depreciated brings the total to \$278 million, after rounding to the nearest million.

How much these figures will mean, once the Parsons appraisal report is submitted as the basis for discussion of the disposal program, appears to be a moot issue. RFC officials are expected to insist that book value not be given any weight in setting sales figures for the rubber plants. The instructions of RFC for carrying on the appraisal study specify that current replacement value should be ascertained. That is the purpose of making the engineering appraisal. That RFC intends the appraisal report to guide any negotiations for selling the plants seems obvious, since the appraisal is being done by an independent organization. One of the conditions of the appraisal contract is that the engineering firm must remain independent of any relation with synthetic rubber for a considerable period beyond the time it completes its report to RFC. The rubber industry, in its report to RFC last August, put some weight on current book value as a guide to establishing sales prices, although it by no means suggested that current book value be used as a ceiling on sales prices. It said, rather, that sales prices should not be below current book value. It seems, however, that RFC feels that current book value should not enter into the establishment of sales prices at all. The rubber companies apparently feel—or felt in August—that some weight should be given to the fact that much of the original plant investment has already been depreciated.

FTC Tire Discount Rule Still Not Settled

It looks like it may be years before the legality of the Federal Trade Commission's quantity limit rule covering discounts granted by manufacturers of replacement tires and tubes is finally settled. The ruling—limiting the top quantity discount for replacement tires and tubes to a 20,000 pound carload, ordered at one time for one delivery—was issued last January and promptly challenged by virtually every tire maker, some mass distributors, and by 35 Chicago tire dealers; most of the dealers were of medium or larger size. They brought suit in Federal District Court in the District of Columbia to have the FTC ruling declared invalid and to have FTC permanently enjoined from issuing such a ruling.

Judge Matthew McGuire, of that court, ruled November 26 that the company motions were premature because no one had been injured yet by the FTC ruling. He refused to rule on the legality of the FTC order and, on December 10, issued an order dismissing the company motions. In the same order Judge McGuire extended a previous stay of the effective date of the FTC tire limit ruling. While the case was before him, he had stayed the original effective date of April 7 until he disposed of the case. On December 10, he ordered the FTC not to put the ruling into effect pending the outcome of an appeal of his dismissal of the company motions in the Court of Appeals. Judge McGuire gave the plaintiffs five days in which to file notice of intention to appeal with the Court of Appeals and

a total of 40 days in which to submit briefs to the appellate court. He made the stay of the FTC ruling, which was requested by the plaintiffs, contingent on the plaintiffs taking their appeal to the Circuit Court promptly.

If the Court of Appeals confirms Judge McGuire's ruling, the plaintiffs appear almost certain to take the case to the Supreme Court. If they fail there, the next step apparently will be a refusal to comply with the FTC ruling, to bring about enforcement action by FTC. An FTC order to comply would then be appealed to the courts, possibly making the same circuit from District Court, to Court of Appeals, and then to the Supreme Court. A procedure like this could take years.

Tire manufacturers contend that the FTC ruling would force them to revamp their price structure from an annual volume basis for granting discounts to a quantity basis. They also contend that the quantity discount limit imposed by the FTC is arbitrary and that the FTC was in error in finding that current discounts tend to monopoly and injure competition among dealers. Such a finding, under the Robinson-Patman Act's quantity limit proviso, is necessary before the FTC can issue a quantity limit ruling.

Mass distributors of private-brand tires make the same case and point out that they could not cover their costs of merchandising, advertising, guarantee adjustments, distribution, etc., under the small discount which would be the ceiling under the FTC ruling.

The National Association of Independent Tire Dealers, in a statement after Judge McGuire handed down his decision November 26, said the decision "tends to support our original position that the ruling ought to be allowed to stand; only if it is given a chance to work can we tell whether it is a just ruling." NAITD, in the proceedings before FTC which led to the issuance of the tire limit order, sought a ruling limiting top discounts to purchases of \$600,000 a year, a far more liberal restriction than the carload quantity limit imposed by the FTC.

Only the National Federation of Independent Business, a group including some tire dealers, greeted the court's decision with complete enthusiasm.

The FTC and the representatives of the Attorney General, who is handling the government's case in the courts, have steadfastly opposed lengthy stays of the effective date of the FTC ruling in the court preliminaries thus far. They have argued, and will before the Court of Appeals, that court stays to which the government does not consent cannot be granted. The FTC wants the ruling to go into effect so that a test case on the validity of the ruling can be made immediately.

Customs Simplification Bill Favored

The Presidential mission which made an on-the-spot economic survey of Europe last fall urged that the proposed Customs Simplification Bill, to which the rubber footwear industry took certain exceptions over the past few years, "should be revived promptly and passed" by Congress.

The mission, headed by Secretary of Commerce Charles Sawyer, issued a unanimous report December 18. The seven-man mission, which included two business men, urged passage of the Customs Simplification Bill to help stimulate trade between Europe and the United States. The Bill

passed the House in the last Congress, but did not reach a vote in the Senate.

The rubber footwear industry, manufacturers and organized labor alike, have opposed a section of the proposed bill which would eliminate from current customs procedures use of the American selling price as the base upon which to calculate import duties for rubber footwear—duties levied as a percentage of the wholesale value. American selling price is so used for only a small number of imported items, chiefly rubber footwear and certain coal-tar chemicals, and found its way into the law as a special protection against "cheap" foreign imports, particularly from Czechoslovakia and Japan, in the case of rubber footwear.

To make certain that the import duties imposed on such items were not watered down so as to become meaningless, Congress some years ago ruled that the duties on important rubber footwear should be assessed on the basis of the wholesale price at which comparable articles are sold by American manufacturers in the domestic market. Opposition to eliminating American selling price has focused attention of the hopelessness of trying to determine a meaningful foreign wholesale price for goods produced under "slave" labor conditions.

Proponents of the Customs Simplification Bill have acknowledged the validity of this point and given verbal assurances that the current duties on imported rubber footwear will not be lowered in terms of dollars-and-cents protection for the American manufacturer, even if this policy means increasing the rates of duty. The duties on rubber footwear are levied in terms of percentages (ad valorem duties)

of the wholesale price. Elimination of the American selling price is advocated in order to put the import tax procedure on a uniform basis. All ad valorem duties, with the few exceptions noted above, are based on the wholesale value of the country of origin.

M-2 Order Change

Many small users were relieved of the task of filing monthly rubber consumption reports by an amendment to Rubber Order M-2 issued December 11 by the National Production Authority. The change practically reinstates the reporting requirements of M-2 to the type in effect before March 1, 1951, when the monthly rubber report NPAF-3 was filed only by companies consuming or owning specified quantities, or in excess of those quantities.

Under the new amendment, companies must file monthly reports only if they consume during the month or own at the end of the month, the quantities equal to or exceeding the following (figures in pounds): dry natural rubber, 15,000; natural rubber latex, 5,000; GR-S types, excluding latex, 15,000; GR-S type latex, 5,000; neoprene, excluding latex, 5,000; neoprene latex, 1,000; nitrile type rubber, excluding latex, 5,000; nitrile-type latex, 1,000; butyl types, 5,000; reclaimed rubber, 15,000.

All companies using or owning rubber must continue to file annual reports. The monthly reporting requirement was relaxed, according to NPA Rubber Director Walter A. Krappe because improved availability of rubber makes complete sta-

tistical reporting of industrial rubber supplies no longer the urgent matter it was during the severe scarcity period following the Korean outbreak. Krappe said that relieving small users from monthly reporting will not minimize the usefulness or accuracy of NPA rubber statistics.

Decontrol Urged for Rubber

Top echelon decontrol officials at the Office of Price Stabilization have under consideration recommendations from the agency's Rubber, Chemicals & Fuels Division to suspend price ceilings on natural rubber and on commercially produced petroleum butadiene.

Details of the rubber decontrol recommendation are not available, but it is known to provide for reinstatement of ceilings in the event market prices increase to some predetermined level. The market bellwether, in this case, would be the #1 RSS contract on the New York Commodity Exchange.

Privately produced butadiene, which would be decontrolled under another recommendation, accounts for about 8% of total output, with RFC accounting for the balance. RFC's production has always been exempt from price controls. OPS, it is reported, was upset when RFC in September, 1952, offered its petroleum butadiene on the open commercial market at 18¢ a pound, f.o.b. plant. RFC evidently failed to inform OPS in advance of this action. RFC shortly thereafter withdrew its offer, as soaring demand for GR-S required the use of all petroleum butadiene available to the rubber program.

Other National News

RMA Sees Possible New Record Year for 1953

Based on the accelerating tempo of rubber goods production in the last quarter of 1952, a new-all-time consumption record is forecast for 1953 by the rubber industry's research statisticians in predicting the use of 1.3 million long tons of new rubber in 1953. This prediction was part of the RMA year-end report, which pointed out that the industry wound up 1952 almost completely free of use controls and would score its second largest rubber consumption record in 1952.

Consumption was higher in only one other year—1950, when the Korean war hysteria touched off wave after wave of scare buying. The 1952 consumption is estimated at 1,250,000 long tons of new rubber, as compared with the 1950 peak of 1,258,577 long tons. The industry consumed 1,214,298 long tons in 1951.

As compared with last year, rubber consumption by type was:

	1951	1952
Natural rubber.....	454,015	450,000
Synthetic rubber.....	760,283	800,000
Total new rubber.....	1,214,298	1,250,000
Reclaimed rubber.....	346,121	280,000

For the rubber goods manufacturer, 1952 was "emancipation year," the RMA said. When, in April, NPA lifted all rubber consumption controls, except for a token restriction on the use of pale crepe rubber, the industry was free of government-imposed restrictions for the first time since June, 1941.

Not only were use restrictions lifted, but at the end of June the General Services Administration relinquished the role of exclusive buyer of natural rubber which it had held since December 29, 1950, and returned buying to private industry. The GSA remains in the rubber picture only as the custodian of the stockpile and as purchaser of rotation rubber and small additional strategic stocks.

By the same token, 1953 looms as the "year of decision" with respect to the problem of getting the nation's vast, government-owned synthetic rubber industry into private hands, the RMA emphasized.

The roadblock to disposal has been up to this point the proper insistence by Congress that as a condition of sale the nation must first have an adequate security stockpile of natural rubber and a synthetic rubber industry capable of standing on its own feet in free competition with natural rubber.

These conditions have now been satisfied. The industry, the Defense Department, and the many other agencies of the government concerned with the problem agree on that point. The government has accumulated a natural rubber stockpile sufficient to carry us through more than five years of all-out war, without any imports during the war period. Moreover there is in being a synthetic rubber industry capable of producing more than a million tons of high-quality rubber per year.

Not only are these basic conditions satisfied, but in addition the rubber goods manufacturing industry has had more than

10 years of experience with upward of 700 different types of synthetic rubber, many of them superior for certain uses to any rubber or rubber-like material heretofore known.

Under Congressional directive RFC is now preparing a preliminary report on a disposal program. The report must be submitted to Congress by March 1, 1953. Forty-five days later, on April 15, 1953, the new President is required to submit specific disposal legislation to Congress.

Since the Rubber Act of 1948 expires March 31, 1954, it is the confident hope and expectation of the rubber manufacturing industry that private ownership and operation of the synthetic rubber plants will by then be an accomplished fact. This confidence has been greatly strengthened by indications that new national administration will rely more on private enterprise and less upon the agencies of the government to administer the affairs of the industrial community.

Only the fact that the synthetic rubber plants were able to supply the industry's new rubber requirements enabled manufacturers to meet 1952's near-record civilian and military demand for rubber products. Moreover this industry, with a gross product valued at more than \$5 billion, closed the year with its distribution pipelines filled to their normal levels.

Tires paced the heavy consumption that followed generally through other divisions of the rubber goods manufacturing industry. Passenger-car tire production is estimated at 73 million units for 1952, as compared with 66 million in 1951. Output was divided as follows: 47 million units for

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replacement, 24 million for original equipment, two million units for increase in inventory and export shipments. The industry expects both truck and passenger-car tire production in 1953 to exceed the 1952 level.

The industry's forecast is that mechanical rubber goods, including industrial types of belting and hose, will share the high level of demand seen for tires in 1953.

Foam sponge rubber, one of the sensational developments in the rubber industry, scored new gains in 1952—with one of the significant factors being development of synthetic latices that captured 40% of the growing market heretofore dominated by natural rubber latex. Excessively high prices for natural latex stimulated development of synthetic latices that were able to compete successfully with the older raw material. Fastest growing new markets proved to be those for furniture and automobile upholstery.

Lighter mechanical rubber goods, such as molded and extruded products, showed production gains on growing demand from manufacturers of automobiles, trucks, refrigerators, washing machines, radio and television sets, vacuum cleaners, and literally thousands of other items.

The rubber heel and sole industry saw its products capture more than one-half of the new shoe and slipper market in 1952 and hailed the introduction of a new item that enjoyed immediate consumer popularity—cellular crepe heels and soles. This material took the place of natural crepe rubber products, manufacture of which was prohibited by the NPA M-2 Order during most of 1952.

Sales of camelback for recapping continued at a high level in 1952 despite competition that came with the introduction last year of the second-line tire. Recapping of farm tires and the "winterizing" and "snow-treading" of used tires continued to show substantial gains.

Introduction of new, high-style lines in rubber footwear and rubber-soled canvas footwear enabled that segment of the industry to improve its sales. With such other segments as the coated materials, drug sundries, flooring, and stationers rubber goods manufacturers, the footwear industry expects improved volume in 1953.

Factory employment in the rubber goods industry averaged 220,000 clockcard workers in 1952. For clockcard workers in the tire and tube industry average hourly earnings again rose, the latest available figures published by the Bureau of Labor Statistics showing average hourly earnings for factory employees in the tire and tube industry to be about \$2.13 per hour. However most of the tire and tube manufacturers received approval from the Wage Stabilization Board to grant a general wage increase of 10¢ per hour in October, 1952, which will result in even higher level of earnings for these employees by the end of 1952, the RMA said.

The inferior quality of a large proportion of natural rubber shipped into this country presented manufacturers with one of their most difficult problems in 1952. Under exclusive government purchase it was possible for the first time to analyze all imports on a quality basis. Both the industry and the stockpiling agency were shocked to find that 41.6% of all natural rubber imported into this country in 1951 was of quality below the grade contracted for.

In an effort to educate manufacturers on this point and to assist them in getting what they pay for when they buy natural rubber, the RMA instituted a series of nationwide seminars devoted to an ex-

planation of proper purchase and inspection methods. There are approximately 900 rubber goods manufacturers in the United States, and the reasons for demanding better natural rubber quality were carried

to nearly 2,000 of their technical, purchasing, and production representatives at meetings which were held in Akron, Trenton, New York, Boston, Buffalo, Chicago, and Los Angeles.

Collyer Statements on 1953, Rubber Price, Atomic Energy

The rubber goods manufacturing industry in 1953 may have its best year in history, according to John L. Collyer, president, The B. F. Goodrich Co., in his year-end statement. He foresees a gain of 11% in over-all tire sales because many of the record number of automobiles manufactured in the past three years will need replacement tires in 1953.

Expansion of facilities and the development of more efficient manufacturing methods and processes during the past year brought the industry's capacity for producing man-made synthetic rubber to a rate of 1,040,000 long tons a year, which surpasses the previous production peak reached during World War II.

Collyer said the total rubber consumption in the United States during 1952 was about 1,240,000 long tons, and he estimated that about 1,275,000 tons of new rubber, both natural and synthetic, would be consumed in 1953. About 60% of the total new rubber will come from America's own synthetic rubber producing facilities, he added.

The per capita consumption of rubber in the United States today is 17.8 pounds a year, compared with one pound per person in the rest of the world, Collyer explained. As new roads are built in other countries, as more goods and people are transported by motor vehicles, and as standards of living improve, rubber will be in increasing demand throughout the world.

He described the government's decision in 1952 to ask for bids preparatory to estimating the worth of government-owned rubber producing facilities as important to both the people and the industry of America.

"This move is a constructive step in the lease or sale of the synthetic rubber plants to private industry and can help to halt the dangerous trend towards the socialization of the rubber industry in the United States," he declared.

Collyer said that the Goodrich Company made arrangements in 1952 for additional facilities for improving and increasing production at its tire and tube plant in Los Angeles, Calif. A plant is being erected in Calvert City, Calif., by B. F. Goodrich Chemical Co. for the production of plastic raw materials and is expected to be in operation early in 1953. The parent company also opened enlarged regional distribution centers at Dallas, Tex.; Denver, Colo.; Philadelphia, Pa.; Los Angeles and San Francisco, Calif.; and Atlanta, Ga. In Japan, production has started on a vinyl resin plant near Tokyo. In Brazil construction has begun on a plant for the production of plastic raw materials near São Paulo. Both the Japanese and Brazilian plants are owned by associated companies of the B. F. Goodrich Chemical Co.

In other statements during December, Collyer pointed out that the increases in the price of top-grade crude natural rubber which have occurred since the middle of October might be a disadvantage to the natural rubber producers, and speaking before the American Institute of Chemical Engineers in Cleveland, he said that nationalization of our power industry and other closely allied industries is inevitable if the American people do not insist that non-military developments in the field of

atomic energy be privately operated and privately financed.

On the matter of rising natural rubber prices, Collyer mentioned that when top-grade crude natural rubber was selling at 26¢ a pound, America's rubber goods manufacturing industry increased its purchase of this raw material for economic reasons. Recently as much as 38% of the total rubber consumed in the United States was natural; the remaining 62% came from America's synthetic rubber plants.

"The United States is no longer dependent on imported natural rubber, and this raw material will only be purchased when it is competitive in value with America's man-made product," Collyer declared.

The Goodrich president called the attention of the chemical engineers to the fact that in the last 10 years government payments for research have increased from 35 to 56%.

"If this rate of increase should continue, soon private industry will be squeezed out of research, either because government has a monopoly on the talent, or because the discoveries have been socialized," he warned.

It was pointed out that today's decisions on whether atomic energy will remain a government monopoly are bound to have tremendous impact on the field of private investment.

Collyer also questioned the recommendations made by the President's Materials Policy Commission issued in June, 1952, that governments, in effect, "control the supply and flow of the world's raw materials."

These recommendations, he said, would authorize our government to enter into management contracts for foreign materials expansion, and to establish a permanent agency to: (1) make long-term purchase agreements, including price guarantees; (2) provide funds for production loan assistance, and (3) enter into contracts or make loans which provide for sharing of profits with government under certain circumstances.

Such action, he said, would substitute the judgment of government planners at home and abroad for "the judgment of the market place," and this practice "would strike a blow at the very heart of our country's competitive economy."

Collyer said that the Commission's report includes estimates as to the materials situation 25 years ahead, and he doubted that such recommendations could be made for the 1970-1980 period "with any useful degree of accuracy."

Firestone Sees 1953 Record Year

The rubber industry will make a substantial contribution to the high level of business activity which all present economic barometers indicate for 1953, according to Harvey S. Firestone, Jr., chairman of the Firestone Tire & Rubber Co., in his year-end statement.

The industry foresees a record high consumption of rubber and a demand for more than one hundred million tires. The industry is geared to produce this number of tires while meeting all its present commit-

ments for defense products, and this situation indicates that employment will continue at its present high rate, it was said.

The supply of both natural and synthetic rubber will be sufficient to meet anticipated demands, and the ability of the United States to produce ample quantities of synthetic rubber should exert a strong influence in keeping the price of natural rubber at a reasonable level, the Firestone statement said.

The only remaining major government control in rubber is the ownership of the synthetic rubber plants, and sale of these plants to private industry, with the opportunity of operating them free of controls, will stimulate competition. Such action, in turn, should lead to the development of many more new and improved rubber products which will benefit the public, the government, and the manufacturer.

Free competition between synthetic and natural rubber in 1953 should result in the further improvement and development of many rubber products.

Business prospects for tire dealers in 1953 are very encouraging because of an 8% increase in the number of potential purchasers of replacement tires. Unit sales of all types of tires should go up 10% because depleted stocks of truck and bus tires will be replenished.

While the continuation of the present high level of business activity is indicated for the year ahead, the level potentially is much higher, Firestone said. To reach the higher level is the challenge facing business today. The extent to which this challenge is met depends upon the extent to which courage and creative forces are exerted toward new and improved products and services that will give increasingly greater value to the consumer, he added.

Courage and creativeness are, therefore, the foundations upon which business can build a greater prosperity for all of us in the coming year, Firestone concluded.

Non-Tire Outlook Called Good

The non-tire segment of the rubber goods industry looks forward to a good year in 1953, with production equaling 1952 levels and possibly increasing by as much as 10%, Thomas Robins, Jr., president of Hewitt-Robins, Inc., said in his year-end statement.

Companies making rubber products other than tires consumed approximately 350,000 tons of rubber in 1952, and present estimates indicate 1953 consumption may rise to 385,000 tons, or 32% of the industry total.

Plant expansion and modernization programs are scheduled to continue at a high level in several key industries, notably gas and electric power, petroleum, and mining. Also, many states and municipalities are planning extensive building of new roads, hospitals, schools, and other public works. This activity is expected to bring about increased sales of conveyor belts and other industrial rubber products.

Sales of foam rubber cushioning, one of the fastest growing products of the industry, are expected to continue upward. The automobile industry, largest single customer for foamed rubber, expects another big year in 1953. The consumption of foamed rubber by the furniture and bedding industries is also expected to continue to increase.

Barring a new war, rubber usage by the military will probably decline slightly owing to a tapering off in the rearmament

program. This decrease will be more than offset, however, by increased civilian consumption.

Rubber goods manufacturers can look forward to a fairly stable natural rubber market in 1953, unless political unrest in the rubber growing areas increases to the extent of interfering further with production. Synthetic rubber has become a stabilizing factor in the market, protecting manufacturers from run-away prices that frequently occurred when they were solely dependent on foreign imports. Man-made rubber is equal or superior to natural rubber for about two-thirds of total usage and is ready to stand on its own feet without government controls. The new Congress is expected to hold hearings early in the year to consider various proposals for turning the government owned plants over to private operators.

Thomas Expects Good Year

E. J. Thomas, president, Goodyear Tire & Rubber Co., predicted a bright outlook for the rubber industry in 1953, in a talk before the Bankers Club of Chicago on December 12.

More vehicles on the road and more driving by the individual owners of these vehicles means more rubber consumption per vehicle, he declared. A potential tire production for 1953 of more than 100 million tires in the passenger-car, truck and bus, airplane, motorcycle and tractor categories, and the best tire year since 1947, were considered possible.

Rubber consumption for all purposes in 1953 is expected to break all previous records for American industry. Thomas estimated U. S. consumption in 1953 at 1,288,000 long tons.

The Goodyear president also cited growth of markets for newer rubber products, such as foamed rubber and rubber rods, and for the film and plastics products made by the rubber industry.

The future beyond 1953 is not all rosy, however, unless America expands its synthetic rubber production facilities, Thomas warned, and added that we face a rubber shortage by 1960. Natural rubber cannot fill the void because political conditions in most of the rubber growing areas do not encourage new plantings, and it takes seven years for a rubber tree to come into bearing.

In seeking the assignment to operate the world's largest atomic energy plant to be built in Southern Ohio, Goodyear management was moved by two primary considerations, the speaker said.

"First of these is the thought that the survival of our nation and the cause of human freedom may well depend upon developments in the field of nuclear fission. America must lead. That is on the side of national defense and security."

"Second of these considerations is the belief that we are moving into an atomic age which will bring far-reaching change in our economic productivity and social progress. Naturally we want Goodyear to be in step with this great movement."

Humphreys Optimistic for 1953

The rubber industry is expected to have another record year in 1953, according to H. E. Humphreys, Jr., president, United States Rubber Co. Sales of the industry, estimated at a record \$5.5 billion in 1952, should exceed this figure slightly next year, he reported in his year-end statement.

A volume of sales and production during the first half of 1953 which would more than offset any slight decline that might occur during the last half of the year was also predicted.

Supplies of natural and synthetic rubber available to the industry should exceed its ability to consume it, even though rubber consumption will probably exceed 1.3 million tons, or 5% more than in 1952.

The industry expects to sell 8% more passenger-car tires and 13% more truck and bus tires in 1953. Belting, hose, packing, and other industrial products will continue in strong demand, following general high-level industrial activity, it was added. Some weakness was shown in this type of business during mid-1952 owing largely to the steel strike and heavy competition. Volume increased during the latter half of 1952, however, and should continue at a high level well into 1953.

An increase in sales of foamed rubber is expected in view of the large passenger-car production planned by the automotive industry. Widespread acceptance by the furniture industry of foamed rubber as a cushioning material should also contribute to the rising sales curve.

Chemicals and plastics are becoming increasingly important to the rubber industry and hold the greatest promise for growth.

U. S. Rubber, for example, expects a 25% rise in the sales of its Naugatuck Chemical Division during the next two years. This increase will probably be the greatest percentage-wise of any division of the company and will come principally in the sale of agricultural chemicals and resins for the plastics industry, Humphreys stated.

The volume of defense business within the industry did not quite come up to expectations during 1952. It accounted for approximately 10% of total rubber consumed and should account for a similar percentage in 1953. Military tires, rubber tank tracks, military wire and cables, and self-sealing fuel cells for aircraft are the principal items of defense business.

Natural Rubber Industry Looks Ahead

The Natural Rubber Bureau, Washington, D. C., said in its year-end statement that in one sense 1952 was a banner year for the natural rubber industry since for the first time in more than 10 years natural rubber was comparatively free of government controls. When the government-owned synthetic rubber plants are sold to private industry, natural rubber will be embarking on a new competitive experience, in that natural rubber for the first time will be operating in the United States in an open competitive market, the Bureau said. The natural rubber producers have long been looking forward to such an opportunity, it was added.

The rubber growers of Malaya last year embarked on a major replanting program, and seven years from now hundreds of thousands of acres will bear a fresh crop of high-yielding rubber trees ready to produce the increased tonnage that international rubber experts agree will be required.

Warren S. Lockwood, president of the Bureau, pointed out that, "Natural rubber production will not lag behind meeting new consumption needs. We hazard a guess that the natural rubber producing industry, which has a current reasonable capacity of 2,000,000 tons a year, will have a reasonable capacity of 3,500,000 tons in 1975."

Reference was made to the many millions of dollars being spent in a research

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and development program by the natural rubber growers aimed at improving quality and finding new fields for their product. Mention was made of Technically Classified rubber, cyclized rubber for shoe soles, and other developments including a new method of bonding rubber to metal. Further to aid U. S. rubber goods manufacturers solve the quality standard problem, the natural rubber producers are cooperating in the setting up of a new Rubber Shipping and Packing Control Ordinance, effective January 1, 1953.

Harry K. Fisher, consulting engineer in charge of the Bureau's rubber road program, was quoted as saying that 1953 looks as though it is going to be the biggest year to date for rubber roads.

The war against the Communists in Malaya is going better under the leadership of Sir Gerald Templer, and the initiative is now definitely in the hands of the Government forces, it was said.

Plastics Outlook Also Called Good

Sales of raw materials in the plastics industry during 1952 will be close to those of 1951, the record year for plastics sales volume, George C. Miller, vice president in charge of sales, Bakelite Co. Division of Union Carbide & Carbon Corp., declared on December 22.

The year 1953 is expected to be a good one for the plastics industry, Miller continued, and a combination of factors for 1953 could possibly result in a new record sales year for plastics.

Practically all types of plastics enjoyed substantial growth in 1952, attributed to the development of many new applications together with continued growth of the vast majority of older applications.

Although certain types of plastics will proceed at a more rapid pace than others during the next few years, Miller said, "There is no reason to believe that the presently large annual sales of two billion-plus pounds for the plastics industry will not double or even triple over the next five to ten years."

A leader in the rapidly expanding plastics industry is polyethylene; while a projected expansion of about 20% for vinyls and polystyrene in 1953 was foreseen.

Vinyl resins for production of calendered film and sheeting and general-purpose molding and extrusion requirements are in adequate supply and are expected to continue to be so for some months to come. Polyvinyl acetate is also in good supply, but polyvinyl butyral may well be in short supply in the next few months, largely because of expanding automobile production and increasingly popular demand for safer vision—which means more laminated safety glass per car.

Vinyl resin plastisols and organosols are currently in good supply, Miller said, but this situation cannot be expected to continue indefinitely because of such large and growing applications as dolls, rain boots, work gloves, and dip coatings for wire household goods and novelties.

Vinyl resins for cloth coatings and for unsupported sheeting registered gains in 1952, as did vinyl resins for surface coatings, because of the increased recognition of their value as extremely durable and long-life coatings under even extreme corrosive conditions.

Vinyl resins for hard-surface floor coverings, such as floor tile and yard goods, experienced substantial gains in 1952. Almost every major producer of hard-surface floor covering is now making

products of vinyl resins, including those now manufacturing felt base, inlaid linoleum, asphalt tile, and rubber tile.

The use of phenolic resins continues to advance in the field of large molded parts such as television cabinets. One of the more recent large molded uses is in the portable refrigerator field, which employs styrene plastic as well. Other advances that are expected include large molded pieces in the furniture field.

The large tonnage for styrene plastic applications gives every indication of continued growth, Miller said, in the fields of housewares, toys, wall tiles, and refrigerator parts. The rubber-modified styrenes are proving increasingly popular in an ever-widening circle of applications demanding better shock resistance than can be achieved by unmodified styrene.

Hoover Predicts Intense Competition

The big challenge to each member of the chemical industry in 1953 will be that of lowering manufacturing and distribution costs wherever possible in order to meet the intense competition resulting from an ample supply of most chemicals relative to demand, J. R. Hoover, president of the B. F. Goodrich Chemical Co., said in his year-end statement. Although industry sales have been increasing, earnings have been decreasing; this is because of the added costs of materials, labor, distribution, and, of course, the high corporate tax rates now in effect.

With the monumental expansion program spurred on by the Korean situation in the last two years, it is a certainty that the industry will have to expend even more energy in technological improvements, to achieve greater yields and lower costs, and in salesmanship to utilize existing capacity.

Both small and large businesses are looking toward June, 1953, to see what the new national administration will do when the present excess profits tax law expires, Hoover said. It is hoped that this law will be allowed to expire without reextension, or at least be modified to resemble the old 52% normal business tax. Some such stimulant should be provided so that industry will have the in-

citive to continue the growth necessary for a healthy economy.

Hoover concluded by saying the years ahead will present both an opportunity and a challenge for the chemical industry. Just as government economy is one of the biggest problems that President-elect Eisenhower will face, so too must industry tighten its belt in readiness for a highly competitive period in which a premium will be placed on sound planning, maximum efficiency, improvements in products and processes, lower costs of manufacture and distribution and sound marketing.

Name Sales Managers

Appointment of three new divisional sales managers for the General Tire & Rubber Co., Akron, O., were announced last month by Howard A. Bellows, vice president. The changes affect the three key market areas of Boston, Buffalo, and Akron.

Named to head the Boston division was J. W. Bogle, who joined General Tire in 1945 and recently headed the Richmond division.

The new Buffalo division manager is H. B. Nelson, former manager of truck tire sales for the New York division. He is a veteran of 33 years in the tire business.

Ori T. Lee has taken over the duties of Akron division sales manager. He was former manager of truck tire sales for the Twin City division and has a background of 23 years' experience in tire sales and service.

Paul E. Nelson, Akron division sales manager for the past two years, has been promoted to the new position of manager of fleet and national sales and will direct the handling of fleet and national sales accounts for General's commercial sales division. He joined the tire firm in 1944 after working for Socony Vacuum Oil Co. and Electric Autolite Co. Prior to his Akron division managerial assignment, Nelson was a territory representative for General's New York division and later Kansas City division head. During World War II, he made a vital contribution to the government's Chemical Warfare department by developing a method for reconditioning gas mask covers. Before starting on a sales career, Nelson was well known in the entertainment field.

Yoquelet in New Post

Auburn Rubber Corp., Auburn, Ind., has elected Glen E. Yoquelet, who was vice president, treasurer, and a director for many years, to the position of general manager, succeeding the late David M. Sellew. Mr. Yoquelet had been serving as assistant general manager of the company for several years.

Prior to his association with Auburn Rubber in 1939, Mr. Yoquelet was district office manager and district office accountant for the Firestone Tire & Rubber Co. He also spent 10 years with the Auburn Automobile Co. in various capacities.

Mr. Yoquelet stated that under the new stock ownership plan every executive, supervisor, foreman, and key employee is now a stockholder in the company, and controlling interest in the corporation's outstanding stock is now vested in this group.

Auburn Rubber manufactures shoe soles and heel materials, rubber toys and Tred stick-on soles. The firm is now entering its forty-third year in the industry.



Glen E. Yoquelet

New Mansfield Set-Up

M. L. Bayer is now factory manager, and H. P. Partenheimer, director of research and development in a revision of production and technical departments of The Mansfield Tire & Rubber Co., Mansfield, O., according to President James H. Hoffman.

Prior to their new appointments Bayer had been general plant superintendent, and Partenheimer, manager of the development department. Bayer is a veteran of 20 years in tire and tube production, and Partenheimer has been a tire engineer in construction, design, and compounding for 35 years. Before coming to Mansfield in 1941, Partenheimer was with The B. F. Goodrich Co. and with Fisk Rubber Co.

Other changes in the development and research departments involve new positions for five other Mansfield personnel, all reporting to Partenheimer.

Robert C. Hudson, development engineer, becomes manager of product design and construction. He was with Firestone Tire & Rubber Co. before joining Mansfield.

Roscoe M. Gage, manager of the technical division, has been made manager of compound development. With Mansfield since 1933, he previously had been with Portage Rubber Co., Vulcan Rubber Co., Hood Rubber Co., and Fisk.

F. Kenneth Miller has been named manager of field engineering and product testing. He was formerly product development engineer and previously had been with James C. Heintz & Co., and with Goodyear Tire & Rubber Co.

Charles P. Wilcox, head of mold engineering, has been appointed manager of mold design. He was with Fisk before coming to Mansfield in 1933.

New manager of statistical quality control is Bernard M. Mahoney, who was formerly manager of the specifications department.

Named special assistants to Bayer are R. V. Schotta, D. H. Landers, and H. H. Forrest, previously shift and divisional superintendents.

In addition five new departments have been created, each headed by a general foreman. Assigned these posts are J. A. Willard, in charge of Banbury mixing, calendering, and tread tubing; William Dormaier, in charge of stock preparation, beads, and tire building; Samuel Johnson, tire curing and airbag departments; and Robert T. Murphy, tire final finishing, inspection, and repair. The fifth general foreman in charge of inner tubes is yet to be selected.

McElroy in New Safety Job

Robert W. McElroy has been advanced to the newly created position of director of safety and security for Minnesota Mining & Mfg. Co., St. Paul, Minn., and its subsidiaries. McElroy will coordinate all phases of safety, security, and fire protection in 3M plants, warehouses, and offices and those of 3M subsidiaries. McElroy has been plant protection manager at 3M since 1945. Prior to that he was director of protection for the Rocky Mountain division of Montgomery Ward & Co. He is chairman of the plant protection division of St. Paul civil defense.

Jerome M. Mayer has been named manager of fire protection. Mayer has been 3M safety engineer since 1945. For 18 years previously he was safety engineering inspector with the National Inspection Co. of Chicago.



Hugh S. Ferguson

Dewey Board Chairman; Ferguson Company Head

Directors of Dewey & Almy Chemical Co., Cambridge, Mass., have elected Hugh S. Ferguson president and chief executive officer, effective January 1, when Bradley Dewey, president since the company was founded in 1919, retired as such under the company's retirement plan. Bradley Dewey was elected chairman of the board.

Mr. Ferguson, 52 years old, has been with the company for 28 of its 34 years. Starting in the factory, Mr. Ferguson at one time or another served in purchasing and as assistant to the president and has represented the company in negotiations and contacts with customers and in arranging financing. He has played a part in the planning, design, and organization of the company's factories and has traveled extensively in connection with its foreign operations. Mr. Ferguson was elected a director of the company in 1927, treasurer and general manager in 1930, vice president in 1944, and executive vice president in 1948.

He has had an active part in all phases of the company's growth from a one-factory manufacturer of sealing compounds for cans and other types of containers into a worldwide chemical organization supplying basic industries such as food, clothing, construction, transportation, health, and recreation, with seven plants in the United States and six abroad, in Canada, Europe, South America, and Australia.

Expands Plasticizer Line

Harwick Standard Chemical Co., 60 S. Seiberling St., Akron 8, O., has expanded its line of plasticizers by adding Hatco Chemical Co.'s high purity plasticizers. These materials have a minimum ester content of 99.7% and give better plasticizing efficiency than conventional plasticizers, it is claimed. In addition, all impurities, such as aldehydes and ketones, have been removed by Hatco's special process. The Hatco plasticizers include dicapryl phthalate, di-iso-octyl phthalate, dibutyl phthalate, diethyl phthalate, dioctyl sebacate, and dibutyl sebacate. Addition of the Hatco materials rounds out Harwick Standard's previous line of plasticizers which includes Polycizer 162 (dioctyl phthalate), Polycizer 332 (dioctyl adipate), and tricresyl phosphate.

Atomic Corp. Assignments

Production authorities selected from the worldwide organization of The Goodyear Tire & Rubber Co., Akron, O., have been assigned supervisory duties with Goodyear Atomic Corp., which will operate the government's gigantic Uranium-235 plant, now under construction in southern Ohio.

Personnel approved by the Atomic Energy Commission and announced by Albert J. Gracia, manager of the newest Goodyear operation, are:

Okie Carlson, superintendent of cascade operations, transferred from St. Marys, O., where he was division superintendent on Goodyear mechanical goods production.

Jay B. Mitchelson, superintendent of chemical operations, transferred from duties of assistant manager of the company's chemical engineering division at Akron.

John R. Arndt, superintendent of product plant operations, transferred from supervisory duties on tire production at Akron.

Arthur H. Wernecke, superintendent of the uranium control department, also transferred from Goodyear-Akron where he was in charge of the methods section of the efficiency division.

All four will report to George H. Reynolds, superintendent of the production division.

Mr. Gracia also announced the appointment of William H. Taylor as superintendent of design and development, and Howard L. Caterson as head of inspection. Both men are under D. H. Francis, director of Atomic Corp.'s development engineering division. Taylor was section head in Goodyear's research organization since 1947; while Caterson, since January, 1952, was plant engineer at Goodyear Aircraft Corp., Akron, where he supervised electrical design and construction work for Plant F.

Assuming the post of superintendent of employee relations with Goodyear Atomic Corp. will be Lloyd E. Fuller, manager of supervisory training and assistant to the personnel manager at Goodyear's Los Angeles plant. Named superintendent of the Atomic Corp.'s plant protection department is John F. Hogan, plant police chief at the Akron plant of Goodyear Aircraft. Both men will report to H. C. Hildiard, manager of industrial relations of the Atomic Corp.

New Corporate Structure

The directors of The Bearfoot Sole Co., Wadsworth, O., have announced the completion of a merger between The Bearfoot Sole Co., a Massachusetts corporation, and The Bearfoot Sole Co., an Ohio corporation, whereby the latter assumed all the assets and the liabilities of the former on November 1, 1952. The Ohio corporation is the only survivor.

The directors included Edwin, Irl B. Ernest, and Timothy D. Calvin, C. E. Chandler, Robert C. Brouse, and Horace Guild. Guild resigned on November 21.

Officers of the new corporation follow: chairman of the board, Edwin Calvin; president, Irl Calvin; vice president and treasurer, Ernest Calvin; executive vice president, Timothy Calvin; vice president and secretary, G. C. Worthington; the following vice presidents: Homer Beaver, in charge of production; L. E. Hardwick, sales; J. M. Calvin, export and New England sales; E. E. Calvin, personnel; Edward Gulbis, research and development; and B. D. White, Sr., also chief engineer; assistant secretary, Attorney Brouse.

Expands Rubber Operations

New appointments at The Parker Appliance Co., Cleveland, O., announced December 3 by S. B. Taylor, president, reflect a further expansion of company operations in the formulation of rubber compounds and the cultivation of new markets for O-rings, special gaskets and seals, and related rubber products.

E. L. Carlotta, who since early 1950 has headed rubber sales for Parker, has been made manager of all rubber research and development for the company. Succeeding him as manager of rubber sales is Frank A. Depatie, who has been engaged in sales work for Parker for the past three years.

About three-quarters of Parker's present output of rubber products serve aeronautical purposes. The company however, is undertaking to broaden its base of operations to cover new products and new markets.

A recognized authority in the field of precision rubber molded products for industrial and aircraft use, Carlotta, before joining Parker in 1941, served as a rubber research chemist with the Pennsylvania Coal Products Co., and the Industrial Rayon Corp.

Depatie was graduated from the University of Wisconsin, where he also served as a member of the faculty. He came to Parker in 1948, from the Standard Oil Co. (New Jersey) where he had been a petroleum engineer in Venezuelan operations.

William T. Stephens, formerly vice president and general manager of Valve Service Co., has joined Parker Appliance as staff engineer in charge of the company's development program of industrial hydraulic equipment.

Increases Research Staff

Godfrey L. Cabot, Inc., Boston, Mass., carbon black manufacturing firm, has announced that the staff of its research and development department in Boston has been expanded to include eleven additional chemists and chemical engineers.

New members of the applied research section include Frank A. Magno, Louis F. Sola, and Henry P. Donohue; applications research and technical service section, Willard F. Roemelt, Richard V. Does, W. Gerald Burbine, and William J. Casey; fundamental research section, Joseph P. Hall and Robert W. Dingman; organic research group, Joel Yancey.

Thomas E. Stretton, new to the process design and economics section, research and development department, was formerly a member of the Cabot economics department until his recent transfer.

Brooks, Polachi Advanced

Edwin B. Brooks, vice president of Binney & Smith Co. International, 41 E. 42nd St., New York 11, N. Y., has been elected president. Charles A. Polachi succeeds him as vice president and has also been elected a director of the company.

Mr. Brooks, who started with the parent organization, Binney & Smith Co., in 1936, has piloted the export activities of its international subsidiary since it was started in 1949.

Mr. Polachi joined the technical sales staff of Binney & Smith Co. International at that time.

Basic Materials Exposition

The "Exposition of Basic Materials for Industry," a new industrial show to cover the whole range of new materials for product development, will be held in Grand Central Palace, New York, N. Y., on June 15-19. Don G. Mitchell, president of Sylvania Electric Products, Inc., is chairman of the board of sponsors which consists of top executives of 20 major companies, including John R. Hoover, president of B. F. Goodrich Chemical Co., and F. M. Daley, president of Sponge Rubber Products Co. The exposition is under the management of Clapp & Poliak, Inc.

A series of technical conferences will be held in conjunction with the Exposition to discuss the properties and potentialities of new materials. These conferences will provide a clearing house for information on materials to the more than 15,000 executives and engineers expected to attend. Both the Exposition and the conferences will cut across industry lines to introduce the new products to hundreds of different types of manufacturers. Admission will be restricted to top management executives, project engineers, product designers, materials engineers, production experts, research men, and sales and marketing executives.

Carbon Black Shipping Carton

The problem of shipping carbon black, especially to foreign plants, has been solved by an improved container developed by The Firestone Tire & Rubber Co., Akron, O., in conjunction with Witco Chemical Co., New York, N. Y. Shipping of carbon black in paper-bag packages presents a problem in that even a small tear in the bag allows the finely powdered black to create a hazard. The new container consists of a fiberboard carton which supports an inner bag of compressed carbon black weighing 50 pounds. Compressing of the black removes air from the package and forms a briquette which, because of its density, helps support the package. The rectangular shape of the carton resists punctures and is easy to handle, it is claimed. If a puncture does occur, the compressed black does not flow out of the rupture. A trial shipment to Firestone's plant at Port Elizabeth, South Africa, showed the new container to be greatly superior to the older paper bag package, and Firestone plans to use the new container for future shipments of carbon black to its overseas plants.

Walnut Shells as Mold Cleaner

Finely ground English walnut shells are used by Firestone to clean aluminum tire molds, replacing sand or other materials liable to pit the aluminum. The powder is used for blasting the mold surfaces and then is drawn off by a vacuum tube. Firestone buys some 125,000 pounds of ground walnut shells per year for use in mold cleaning.

Harold W. Burkett, treasurer, U. S. Rubber Reclaiming Co., Inc., Buffalo, N. Y., and A. M. Adamson, treasurer, Canadian General-Tower, Ltd., Galt, Ont., Canada, have been elected to membership in the Controllers Institute, 1 E. 42nd St., New York 17, N. Y.

Diamond Alkali Ups Two

New assignments for two members of the Diamond Alkali Co. sales organization, Justus U. Belville and Kemble S. Lewis, were announced last month by W. H. McConnell, director of sales.

Mr. Belville is now staff assistant to J. C. Forsyth, manager of Alkali specialty sales, at the company's general headquarters, 300 Union Commerce Bldg., Cleveland 14, O.; while Mr. Lewis succeeds Mr. Belville as assistant manager of Diamond's Chicago branch sales.

Mr. Belville joined Diamond in 1941, doing merchandising and specialty sales and service work in the Pittsburgh, Pa., area. Following service in World War II, Mr. Belville returned to his previous duties with Diamond in 1946. That year, following his transfer to the Chicago branch sales office, he was engaged in handling sales of Diamond's chemicals for industry. In 1950 he was promoted to assistant manager of the sales office, which embraces Chicago and midwestern states.

Mr. Lewis has been with Diamond since 1947, when he started in the Chicago branch sales office on technical sales and advisory work on Diamond chemicals for the paint manufacturing industry. He later expanded his sales activities to cover Diamond's complete line of more than 100 chemicals.

John C. Virden, nationally known Cleveland industrialist, has been elected a director of Diamond Alkali.

New Adhesives Plant

Williamson Adhesives, Inc., long established in Chicago, Ill., as a manufacturer of industrial adhesives, has moved into a modern new plant at Skokie, Ill., northwest of the Chicago city limits. This move is the firm's third in 38 years. Also, the third generation of the Williamson name is in management of the company.

The new plant is a modern concrete and brick structure, which more than doubles the manufacturing facilities of the old plant and gives much larger office quarters. Additional ground area provides for future expansion. The building also houses the Williamson specialty compounding division, an important new division of the firm, engaged in the development of new products, and in processing, handling, packing, and shipping special materials.

The new building includes a well-equipped laboratory for adhesive research and production control, a fireproofed room for processing inflammable products, and greatly increased storage space for raw materials.

Form New Company

Bacon Industries, Inc., a new company, has been organized to produce O-rings, gaskets, and similar specialty products formerly manufactured by Frederick S. Bacon Laboratories. According to the announcement by Partners Frederick S. Bacon and Philip D. Wilkinson, the new firm will have manufacturing facilities at 192 Pleasant St., Watertown, Mass., but its direction and management will remain under the parent organization. In addition to O-rings and gaskets, Bacon Industries will serve all needs in the specialty molding field, from parts and mold design to material modifications to meet special requirements.



Alquist Studios

F. McCawley Tolin

Promoted by Alco

F. McCawley Tolin recently was promoted to the position of director of sales for Alco Oil & Chemical Corp., Trenton Ave. and William St., Philadelphia 34, Pa. Mr. Tolin started his business career with E. I. du Pont de Nemours & Co., Inc., rayon division as control chemist and in the production training course. In the latter part of 1938 he joined the Safetex Corp., as plant manager. In December, 1939, Mr. Tolin went to R. T. Vanderbilt Co., in the research and development latex department and then served as technical sales representative until February, 1950, when he became associated with Alco.

C. E. Cain has been appointed head of the sales service division at Alco. Mr. Cain, after service in the U. S. Navy (1941-1946), joined the Firestone Tire & Rubber Co. as a process control engineer in a synthetic rubber plant, then was a development compounding and finally a sales and technical service engineer. In January, 1951, Mr. Cain became chief chemist of Tovad Corp., Latrobe, Pa. He remained there until November 1, 1952, when he signed up with Alco Oil & Chemical Corp.

John P. Seguin has been made technical sales representative of the New England States for Alco and soon will maintain a regional office in or about Providence, R. I. to service the sales of synthetic and natural latex compounds and rubber chemicals to the New England area. Mr. Seguin from 1937 to 1939 was associated with the Diamond Alkali Co. in the research division. From 1939 to 1943, he was with the Kansas City Limeolith Co., as manager and director of research. From 1943 to December 1, 1952, he worked for Firestone's Xylos Division, first in research and development and then as technical sales representative in the Eastern Seaboard States.

National Rubber Machinery Co., Akron 8, O., has completed a new, modernistic office building adjoining its factory at Clifton, N. J. The new structure will house all Clifton production offices, as well as the company's eastern sales offices, which were formerly at 1180 Raymond Blvd., Newark, N. J.

Schwarz Advanced

George W. Schwarz, since 1948 vice president-controller of Wyandotte Chemicals Corp., Wyandotte, Mich., has been promoted to vice president and treasurer. Robert B. Semple, president, announced December 20 following the year-end meeting of the board of directors.

In assuming supervision of the financial administration of the nationwide chemical company and its transportation and mining subsidiaries, Schwarz relinquishes the controllership after a long career in accounting that has brought him many honors from professional societies.

The functions of treasurer have been handled by Ford Ballantyne, Sr., who will continue as vice president and secretary of the company, offices he has held for many years.

Schwarz is a certified public accountant and has served in various accounting capacities with industrial corporations in the Detroit area. In 1925 he joined the staff of Ernst & Ernst, public accounting firm, and in 1938 moved to Wyandotte as controller.

Wyandotte's operations include three plants in Wyandotte, Mich., one of the world's largest quarries at Alpena, Mich., a coal mine in Pennsylvania, clay and volcanic ash mines in Kansas and Mississippi, a compounding plant in Los Angeles, Calif., and a Great Lakes steamship line. The company is a major producer of industrial chemicals for the automotive, glass, construction, cleaner, and other major industries and also carries on a number of research and development projects for defense branches of the government.



George W. Schwarz

Veteran Workers Feted

About 100 members of 30- and 40-year clubs of Miner Rubber Co., Ltd., Granby, P.Q., attended the recent annual get-together at the Granby Hotel. Nine new members entered into the 40-year club, and each received an engraved silver salver, a \$400 check, and a bar to be attached to the 30-year button. The new members bring the 40-year club total to 21.

The 30-year club at the same time gained 19 new members, each of whom was presented with a long-service button and a \$300 check. Membership in this club now numbers 137.

Richardson Upended

William S. Richardson, vice president of The B. F. Goodrich Co., Akron, O., has been elected executive vice president, a director of the company, and a member of the executive committee of the board of directors. Mr. Richardson joined Goodrich in 1926 as manager of the planning department; two years later became staff superintendent of the industrial products division; in 1931 was named merchandising manager of that division; in 1938, division general sales manager; and in 1941, general manager of the industrial and general products sales division. He was elected president of B. F. Goodrich Chemical Co. on its organization in April, 1945, and was elected vice president of The B. F. Goodrich Co., in April, 1951.



Fabian Bachrach

William S. Richardson

Mr. Richardson is a graduate of Technical High School, Boston, Mass. He is a veteran of World War I and during World War II was chairman of the OPA Mechanical Rubber Goods Industry Advisory Committee. He is also a director of the Manufacturing Chemists Association and is presently vice president of that organization.

Schreurs in New Post

Merle F. Schreurs has joined B. F. Goodrich Chemical Co.'s plastics materials group to head the practical fabric coating techniques and processes section. His past experience was gained with Tex-Tileather Corp., and as technical director at Industrial Ovens, Inc. Schreurs is a member of the American Chemical Society, Society of Plastic Engineers, and American Society of Testing Materials.

Martin I. Cowan has resigned as secretary and treasurer of Consolidated Products Co., Inc., New York, N. Y., and has retired from the firm. He had been affiliated with the company, dealer in machinery and plant equipment, for 30 years. His son, Robert C. Cowan, will continue as sales engineer with Consolidated. The senior Mr. Cowan plans to continue his association with the chemical and allied processing industries as a consultant, adviser, and appraiser.

Beebe to Japan

Paul Beebe, manager of process development at Goodyear Tire & Rubber Co., sails from San Francisco for Japan in mid-January to be production manager of the Goodyear "K. K."—Japanese designation for Goodyear Co., Inc.—at Kurume. Beebe will replace J. J. Hartz as production manager covering the production of Goodyear products. Goodyear has a manufacturing agreement with the Bridgestone Tire Co., of Japan. Beebe in 1917 joined Goodyear in the chemical engineering department. After five years he was transferred to compounding and in 1928 was assigned to the California plant as chief chemist. He has been manager of process development since 1935.

Sales Department Changes

A series of organization changes in the Goodyear sales departments was reported last month by Victor Holt, Jr., vice president in charge of tire sales. The changes include two newly created posts in the Akron staff and one in the field organization.

The new home office assignments will be filled by R. W. Fitzgerald, named sales manager of the tire division, and W. A. Kemmel, made manager of the tire departments.

In the new field assignment, F. W. McConky, Jr., northeast division manager, is combining with his present duties those of directing and maintaining top-level contacts with the petroleum companies. McConky will report to Holt as assistant vice president.

Plastic Vibrator for Looms

Wellington Sears Co., 65 Worth St., New York 13, N. Y., has announced that its Lantuck, a non-woven cotton fiber mat developed in conjunction with West Point Mfg. Co., is used as the filler with Synthane Corp.'s L-RF laminate in a new plastic vibrator block for Draper textile looms. Mill tests indicate the new blocks give 60 times longer life than do conventional wood vibrator blocks, as well as being cheaper and lighter in weight.

American Polymer Corp., Peabody, Mass., has appointed Cole & DeGraf, San Francisco, Calif., sales representative. Cole & DeGraf will specialize in the sale of Polymer products to the paint, rubber, adhesive and printing inks and lacquer manufacturers. The firm will also handle the sale and promotion of Polymer's soil conditioner, Agrilon.

Dusal Tool & Mold Co., 241 Centre St., New York 13, N. Y., has expanded into additional quarters at 37-01 Vernon Blvd., Long Island City, N. Y. The new facilities comprise 12,000 square feet of floor space to give Dusal a total of 18,000 square feet. New equipment is being installed to enable the company greatly to expand its moldmaking and other services.

Allan E. Ross has been appointed manager—advertising department, by The Goodyear Tire & Rubber Co. of Canada, Ltd., New Toronto, Ont. He was formerly assistant manager of the department.

Parker Succeeds Rand at Agriculture Bureau

Marion W. Parker, biochemist, botanist, and plant physiologist on December 22 became head of the United States Department of Agriculture's Division of Rubber Plant Investigations, Plant Industry Station, Beltsville, Md. He succeeds Robert D. Rands who retired after 32 years of research work in the Bureau of Plant Industry, Soils & Agricultural Engineering; the past 12 years he spent in rubber plant studies.

Dr. Parker has been in the Bureau since 1936. Most of his time has been given to fundamental studies of the mechanism of light period effects on plant growth, flowering, and fruiting. He is author or co-author of nearly 50 articles in this field. Before coming to the Department, Dr. Parker taught plant physiology and biological chemistry at the University of Maryland and was associate plant physiologist for the Maryland Agricultural Experiment Station. For the past eight months he has been directing the physiological and biochemical studies on *Hevea* under Dr. Rands.

Dr. Rands has built up a wide experience in plant pathology, physiology, and improvement for disease resistance. He spent 3½ years in Java as consultant on rubber problems for the Netherlands East Indies Government. Returning to the Department, he made a rubber tree disease survey in Panama and northern South America. He worked on sugarcane diseases in the South and, with the approaching rubber crisis in 1940, took charge of the Latin American cooperative rubber program. Dr. Rands will continue as a collaborator with the Department.

The cooperative breeding and disease research has conquered the leaf blight which frustrated previous attempts to grow the plantation rubber tree commercially in this hemisphere. Joint activity by the Ford Motor Co. and the Brazilian government quickly revealed resistant strains. The program has developed strains that apparently combine yield with resistance, but more testing is required.

The rubber program (joint research, local training, technical assistance) represents the pioneer Point IV type of activity in Latin America. It provides the necessary technical guidance for an expanding commercial industry in which cooperating governments, private companies, and individuals are investing several millions of dollars annually. Emphasis is given the small-farm type of production where rubber will be an important source of family cash income.



Goebel Retires from RMA

Richard H. Goebel retired as secretary and traffic department manager of The Rubber Manufacturers Association, Inc., 444 Madison Ave., New York 22, N. Y., on December 31. A. L. Viles, Association president, announced that Goebel will be succeeded by George E. Gwinup as manager of the traffic department.

Goebel joined the RMA in 1919 after service in the traffic departments of the Pennsylvania Railroad Co. and the Trunk Line Association of Railroads. He became secretary of the RMA in 1932 and served on several of the Association's product divisions and committees. During the war Goebel was chairman of the two traffic committees of Rubber Reserve Co.

Gwinup joined the RMA in October, 1952, after previous service with Celanese Corp. of America and the Missouri Pacific Railroad Co. He is a member of the faculty of the Academy of Advance Traffic of New York.

New Company Formed

Park Rubber Co., Inc., with offices and plant at Lake Zurich, Ill., is the result of a merger between Rubber Engineering & Chemical Co., Lake Zurich, and Park Rubber Corp., Melrose Park, Ill. The merger provides enlarged engineering and sales staffs and also increased production facilities. Products of the new company will be principally molded mechanical rubber goods and clicking machine pads and blocks for the shoe industry.

Officers of the new company are George M. Field, Jr., president; Robert T. Duffy, Jr., Henry J. Droba, Fred Fuller, vice presidents; and Herbert B. Hill, secretary.

Boston Woven Hose & Rubber Co., Cambridge, Mass., on December 23 completed a reorganization of the company's merchandising and advertising personnel. Accordingly H. Stanley Johnson has been named director of merchandising, and George A. Taylor, advertising and sales promotion manager. Brooke, Smith, French & Dorrance, Inc., New York and Detroit, has been appointed advertising and merchandising counsel.

Willard D. Voit, president of W. J. Voit Rubber Corp., Los Angeles, Calif., was among those honored with business achievement awards by the Minute Magazine of Los Angeles to those "whose achievements have been recognized as exceptional in their respective fields of endeavor." The presentations were made at the December 9 meeting of the Los Angeles Advertising Club. Voit was honored for the fight his company waged to have the rubber covered football recognized officially by collegiate and high school athletic associations.

Randall Duster Corp., Rye, N. Y., recently appointed Anderson & Co., Akron, O., as its distributor in Ohio for dusting machines and powders, replacing National Rubber Machinery Co., which previously had represented Randall in this area. The company's West Coast representative is John W. Bell, Rivera, Calif.; while exports sales are handled by Gillespie & Co., New York, N. Y.

NEWS ABOUT PEOPLE

Max A. Minnig, vice president of the rubber chemicals division of Witco Chemical Co., 295 Madison Ave., New York 17, N. Y., has been elected by the directors of Continental Carbon Co. and Continental Oil Black Co. as vice president in charge of sales for these two companies. Mr. Minnig has been associated with the Witco organization since January, 1946.

Valjean Junior Parker, 22-year-old Goodyear Tire & Rubber Co. apprentice machinist of Akron, O., was chosen to represent Ohio-Michigan region apprentices at the fifty-seventh annual Congress of American Industry in New York, N. Y., last month. He received congratulations of General of the Army Douglas MacArthur, who addressed the Congress' December 5 dinner session. One of 17 young men selected from the apprentice program throughout the United States, Parker was a guest of the National Association of Manufacturers, sponsor of the Congress, during his stay from December 2 through 6 in New York. He was selected as an outstanding apprentice on the basis of on-the-job skill, scholarship, personality, leadership, and citizenship.

Frank G. Moore has been appointed general traffic manager, Columbia-Southern Chemical Corp., Pittsburgh, Pa. Associated with the transportation field since 1914, Mr. Moore has specialized on traffic problems of the chemical industry during the past 35 years. He has served as traffic manager for Columbia-Southern and its predecessor companies since 1934.

James P. Skehan has been appointed manager of the New York branch office of Monsanto Chemical Co.'s plastic division. He succeeds Charles F. Reeves, who retired after 20 years with the company. Skehan joined Monsanto in 1929 as a laboratory assistant in the plastics division's headquarters at Springfield, Mass., became a member of the sales department in 1938, was advanced to assistant sales manager for sheets and Vupak in 1945, was named sales manager for those products two years later, in 1948 was made assistant manager of the plastics division's branch office in New York, and in 1950 was transferred to Washington, D. C., where he represented the division for two years. He was reassigned to the position of assistant branch manager in New York early last year.

Robert T. Baldwin has been appointed executive secretary and assistant treasurer, and **A. B. Bowers**, director of publicity and assistant executive secretary of Association of Consulting Chemists and Chemical Engineers, Inc., 50 E. 41st St., New York 17, N. Y.

M. Adolph Heikkila, formerly engaged in sales promotion for the paint, plastics, chemicals, building, heating, and air-conditioning fields, has joined the technical literature department of Ketchum, MacLeod & Grove, Inc., Pittsburgh advertising agency. He comes from The New Jersey Zinc Co., where he was in the market development division in promoting and developing new products, particularly for the luminescent and rubber fields.

Arthur N. Sudduth has been named manager of the new abrasive division, Whittaker, Clark & Daniels, Inc., 260 West Broadway, New York 7, N. Y., manufacturer, exporter, and importer of non-metallic minerals, pigments, and colors. Mr. Sudduth will supervise the sales and production of a wide variety of abrasives for the finishing of metals, glass, silver, plastic, and for wood finishing. He was formerly vice president in charge of eastern sales and production activities and a director of James H. Rhodes Co.

Robert D. Thomas has been advanced to central division sales manager of The Firestone Tire & Rubber Co., Akron, O., and will supervise the sales organizations of ten districts in five states. Mr. Thomas joined Firestone in its college sales training class on July 30, 1931. He was employed in various factory production positions until he was transferred to the sales department in 1936. In 1937 he became assistant district manager at Cincinnati, in 1938 merchandise manager of the Midwest sales division, and in 1939 district manager at Columbus, O. On February 15, 1942, Mr. Thomas was drafted to serve the government as Chief, Tire Maintenance Division, Office of Defense Transportation, Washington, D. C. On December 12, 1942, he was named Regional Director, ODT, Cleveland, a position he held until September 15, 1945. He then returned to Firestone as district manager at Cincinnati. He later became district manager at Detroit and on February 16, 1946, was recalled to Akron as manager of eastern sales division. In October, 1949, he was appointed Akron district manager. Mr. Thomas is the son of the late John W. Thomas, former chairman of the board at Firestone.

Paul B. Sewell, who has been on an extended leave of absence due to illness, previously had held the position of central division sales manager.

Miss L. J. Baxter has been made director of customer service department, by American Polymer Corp., Peabody, Mass. This is a special department designed to expedite delivery of orders, to coordinate and trace shipments, and to facilitate requests for special products in pilot-plant or experimental production.

W. P. Frisco, formerly technical director at St. Clair Rubber Co., Detroit, Mich., is now factory manager of Vulcan Rubber Products, Inc., Brooklyn, N. Y. During his 15 years in the rubber industry Mr. Frisco has been associated with the manufacture of insulated wire and cable, molded mechanical goods, and coated fabrics.

Robert H. Naylor has been advanced to general credit manager of The GoodYear Tire & Rubber Co., Akron, O., to succeed G. L. Webster, who recently retired. A member of the Goodyear organization since 1925, Naylor's first assignment was as a field credit man in the Boston district. He later served there as district credit manager and subsequently was made eastern division credit manager prior to being named assistant general credit manager at the Akron headquarters in 1936.

George H. Baker has been elected vice president in charge of the employe and public relations department of Wyandotte Chemicals Corp., Wyandotte, Mich. He had joined the chemical company in September, 1950, as director of employe and public relations following broad experience in the field of human relations in both industry and government.

Laurence F. Whittemore, president and chairman of the board of Brown Co.'s pulp and paper operation, recently became president of the New England Council. He has served in many capacities on the Council, including a director from 1930 to 1946, New Hampshire chairman, secretary, and executive committee member.

Howard I. Green, vice president and managing director of Fidelity Machine Co., Inc., Philadelphia, Pa., has resigned. His action coincides with the sale of the Green interests, which represents one of the largest blocks of Fidelity stock. Green was a member of the syndicate which took over Fidelity in 1946 and was responsible for bringing the company to its present position in the development and manufacture of specialized equipment for the textile, wire, and rubber industries.

Clyde L. Jenkins and **Henry Watts** have been appointed superintendent of the materials and service department and purchasing agent, respectively, of the Goodyear Atomic Corp. Both men are veteran employees of the Goodyear Tire & Rubber Co.

Herbert H. Wiedenmann has been made factory manager of Akron Plants 1 and 2 of The Firestone Tire & Rubber Co. He comes from Los Angeles where he was factory manager of the Firestone plant there since 1950. He will become manager of the Akron tire factories. He was hired in California by Firestone on the job of splicing breakers in the stock preparation department in October, 1928. From 1929 to 1934 he worked in the development department; in 1934 he was named general foreman of the stock preparation department; in 1935, general foreman of the materials preparation department; in 1936, manager of the tire building and curing departments; and in 1941, production manager of the tire plant. When the fuel cell division was started in 1942, Mr. Wiedenmann was transferred to it as division manager, a post he held until the end of the war, when he was named assistant factory manager.

Warren E. Scoville, Jr., has been appointed assistant manager of the development department of United States Rubber Co.'s plant in Passaic, N. J., and will be responsible for further development of the 33,000 mechanical rubber and plastic products now made in the Passaic factory, and the development of new rubber and plastic products. Lawrence Cranston is the development manager at the plant, which has approximately 3,100 employees. Mr. Scoville has been in the company's development department since graduating from Stevens Institute in 1934.

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OBITUARY

Herbert I. Scott

HERBERT I. SCOTT, treasurer of The Barr Rubber Products Co., Sandusky, O., died in a hospital at Sandusky, December 10, following an illness of several weeks.

A native of Clarkesfield, O., Mr. Scott was graduated from Wakeman High School and attended the Oberlin School of Commerce.

His first job was as a secretary at National Tube Co., Lorain, but he soon left there to become an accountant for a hardware manufacturing concern. He entered the rubber field with Goodyear Tire & Rubber Co. in 1913 as an accountant and assistant credit manager. He later took a position with the Faultless Rubber Co., Ashland, and after six years went with Hoffman Heater Co. until with a co-worker, the late Nelt Barr, he started The Barr Rubber Co., which was originally at Lorain.

The deceased was a member of Rotary, Cleveland Credit Men's Association, National Association of Cost Accountants, Cleveland Treasurers' Club, the Salvation Army advisory board, and the Methodist Church, where he served 50 years in various capacities, including Sunday School superintendent, on the board of stewards and trustees, and as a lay leader of the Norwalk district of the church.

Funeral services were held December 13 at Trinity Methodist Church, followed by additional services the same day in New London, where he was buried in New London Cemetery.

Besides the widow, survivors include a daughter and two sisters.

Fred J. Wilson

FRED JAMES WILSON, one of the organizers and at one time president of Wilson Rubber Co., Canton, O., died December 6 in a Canton hospital after suffering a cerebral hemorrhage.

Educated in the public schools of Akron, Mr. Wilson started his career in the rubber industry with The B. F. Goodrich Co., in 1893. In 1900 he became foreman of Goodrich, but left there to join Republic Rubber Co. in the same capacity in 1904, and then to become, successively, foreman of Canton Rubber Co., 1905-12, and Faultless Rubber Co., 1913. From 1914-16 he was superintendent of Canton Rubber Co., but resigned to organize the Wilson Rubber Co., where he served in the capacity of vice president and general manager until 1926 when he became president. He retired from office in 1947.

The deceased was a director of Stark Federal Savings & Loan Co., a member of National Association of Manufacturers, Canton Chamber of Commerce, the Rotary Club, and the Canton Automobile Club. He was active in Trinity Reformed Church, where he served as a deacon and an elder, and also belonged to the Blue Lodge, Scottish Rite, Commandery, and Shrine.

He was born in Galion, O., on June 10, 1877.

Funeral services were held December 9, followed by interment in Forest Hill Cemetery, Canton.

Survivors include the widow, three sons, and three grandchildren.

Franklin T. Griffith

FANKLIN T. GRIFFITH, chairman of the board of directors, Griffith Rubber Mills, Portland, Oreg., succumbed to a heart attack, November 7, at his home in Portland.

The deceased was born in Minneapolis, Minn., in 1870. He began his business career as a bookkeeper in California before moving to Oregon in 1891, where he passed his bar exams in 1894, without ever having gone to law school, and soon became a prominent lawyer and head of the Griffith, Phillips & Coughlin law firm.

In 1913 Mr. Griffith was made president of Portland General Electric Co. He also served as president and later as chairman of the board of Portland Traction Co., and as president of Title & Trust Co. and of Firtex Insulated Board Co. He became president of Griffith Rubber Mills after the death of his brother, and founder of the firm, Charles R. Griffith, and later chairman of its board.

Because of his interest in many civic projects, Franklin T. Griffith, the first president of the Portland Community Chest and an active participant in affairs for the Shriner's Hospital for Crippled Children, was named Portland's "Citizen of the Year" in 1938.

Survivors include the widow, two daughters, and a son-in-law, Zina A. Wise, president of the rubber company since 1951.

Calvin Provost

CALVIN PROVOST, retired vice president and director of Bloomingdale Rubber Co., Chester, Pa., suffered a fatal heart attack on November 20 at his farm in Maryland, Del.

Mr. Provost was born in Boonton, N. J., July 14, 1873, and received his education in the public schools of that town.

In 1887 he started his career in the rubber industry in the plant of American Hard Rubber Co. in Butler, N. J., but left there in 1890 to work for the old Bloomingdale Soft Rubber Works, Bloomingdale, N. J., which later was reorganized and named the Bloomingdale Rubber Co. In 1910 the deceased was made factory manager; in 1926, vice president and director; and in 1946 he retired.

Funeral services were held in Maryland on November 21. The body was then removed to Chester, Pa., where additional services were held the next day, followed by burial in Chester Rural Cemetery.

Besides the widow, a son, five daughters, ten grandchildren, and five great grandchildren survive.

Thomas J. Starkie

THOMAS J. STARKIE, vice president, director, and member of the executive committee of Witco Chemical Co., New York, N. Y., and a director of Witco Chemical Co., Ltd., of Great Britain, died suddenly of a heart attack December 21 at his residence in New York.

Mr. Starkie was born in New York on December 2, 1892.

He began his career in the chemical field with Harshaw Chemical Co., and in June, 1921, joined Witco.

The deceased belonged to the Uptown, Chemist's, New York, and National Paint Clubs and the Salesmen's Association of the American Chemical Society.

Mr. Starkie leaves his wife, one son, and a daughter.

Elmer Croakman

ELMER CROAKMAN, president of Binney & Smith, Ltd., Toronto, Ont., Canada, died December 25 at the age of 54.

The deceased was graduated from the University of Buffalo, N. Y., in 1918.

Directly after graduation Mr. Croakman started with National Analine Die Co., where he remained until 1924 when he went to Akron, O., to become assistant chief chemist at Philadelphia Rubber Works Co. In 1946 he left there to become president of Binney & Smith, Ltd., in Canada.

Surviving the deceased are the widow, a daughter, a son, and a brother.

The body was bought to Buffalo for burial after services were held in Toronto.

Edwin W. Oldham

EDWIN W. OLDHAM, retired head of Firestone Tire & Rubber Co.'s general laboratory, Akron, O., died December 20 at an Akron hospital, after having been admitted the night before.

Mr. Oldham was born in Akron, 74 years ago. He was graduated from Case Institute of Technology in 1900.

Two years ago he retired from Firestone, with which he had been associated for 30 years.

The deceased was a member of the American Chemical Society, West Congregational Church, was past master and secretary for 12 years of Coventry Lodge, F. & A. M., and active in the Lapidary Society of Akron.

Mr. Oldham leaves three sons, a daughter, and ten grandchildren.

FINANCIAL

Armstrong Rubber Co., West Haven, Conn., and wholly owned subsidiaries. Year ended September 30, 1952: net income, \$1,651,802, equal to \$4.05 each on 390,710 common shares, compared with \$2,832,393, or \$7.28 each on 376,562 shares, in the preceding fiscal year; net sales, \$55,436,947, against \$50,325,336; federal taxes on income, \$2,114,379, against \$4,790,587; current assets, \$24,093,046.60, current liabilities, \$14,481,839.35, against \$19,550,545.17 and \$10,195,561.45, respectively, on September 30, 1951.

Firestone Tire & Rubber Co., Akron, O. Year ended October 31, 1952: consolidated net income, \$43,081,717, equal to \$10.89 a common share, contrasted with \$48,398,950, or \$12.26 a share, in the year ended October 31, 1951: net sales, \$965,364,427, against \$975,766,455; current assets, \$383,740,336, current liabilities, \$95,508,906, against \$317,467,376 and \$116,308,920, respectively, on October 31, 1951.

Okonite Co., Passaic, N. J. Nine months to September 30, 1952: net earnings, \$1,502,986, equal to \$10.03 a common share, compared with \$1,051,179, or \$7.02 a share, in the same months last year.

Phelps Dodge Corp., New York, N. Y. Nine months to September 30, 1952: net income, \$25,643,671, equal to \$2.53 a share, compared with \$31,163,162, or \$3.07 a share in the 1951 period.

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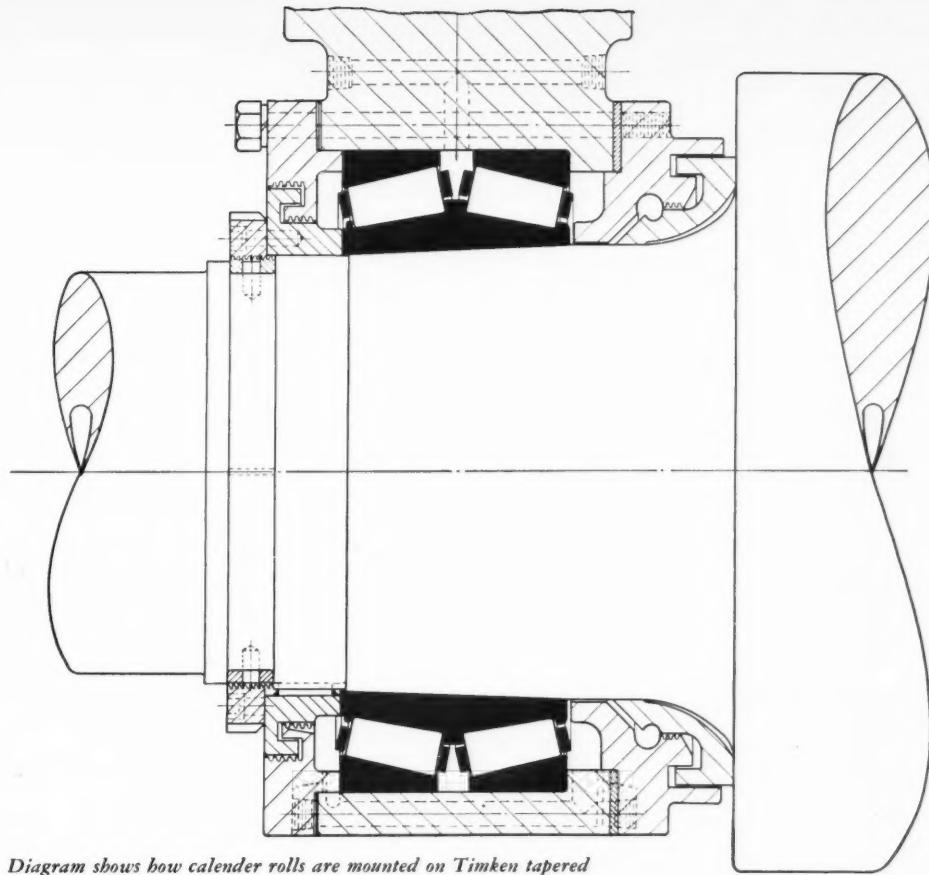


Diagram shows how calender rolls are mounted on Timken tapered roller bearings to maintain gage of plastic film and rubber sheeting.

With calender rolls on TIMKEN® bearings gage stays uniform sheet after sheet

WHEN calender rolls are mounted on Timken® tapered roller bearings, the gage of plastic film and rubber sheeting is held uniform. With Timken bearings, rolls stay in accurate alignment longer than is possible with sleeve-type bearings.

Uniform gage is maintained for the entire length of the sheet and for sheet after sheet. By holding gage to minimum tolerances, Timken bearings increase yield. You get more yards per pound of material.

Because there is no friction between roll neck and bearings, roll neck wear is eliminated. Overhauls are fewer. Downtime is reduced because roll necks don't have to be machined.

Timken bearings have true rolling motion and an incredibly smooth surface finish which practically eliminates wear within the bearing. Precision is maintained.

Their tapered construction permits Timken bearings to take radial and thrust loads in *any* combination. And line contact between their rollers and races gives extra load-carrying capacity.

Why not get all the advantages of Timken bearings in your calenders, mills, refiners, and mixers. For complete information, write The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".



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TAPERED ROLLER BEARINGS

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Circle Wire & Cable Corp., Maspeth, L. I., N. Y. Ten months to October 31, 1952: net income, \$1,877,875, equal to \$2.50 a common share, compared with \$1,699,798, or \$2.26 a share, in the corresponding period of 1951; net sales, \$19,271,163, against \$14,639,340.

St. Joseph Lead Co., New York, N. Y., and domestic subsidiaries. First three quarters, 1952: net income, \$8,332,599, equal to \$3.06 each on 2,716,222 capital shares, compared with \$10,242,802, or \$3.77 each on 2,469,320 shares, in the preceding year's quarters; net sales, \$78,390,417, against \$84,220,610.

Seiberling Rubber Co., Akron, O. First three quarters, 1952: net income, \$671,876, equal to \$1.69 a common share, contrasted with \$1,005,989, or \$2.78 a share, in the previous year's period; net sales, \$31,192,329, against \$33,069,331.

Skelly Oil Co., Kansas City, Mo., and subsidiary. Nine months ended September 30, 1952: net income, \$19,855,983, equal to \$6.91 each on 2,873,059 capital shares, compared with \$22,036,961, or \$7.67 each on 2,611,871 shares, a year earlier.

Taylor Instrument Co., Rochester, N. Y. Quarter ended October 31, 1952: net earnings, \$207,499, equal to \$1.15 a common share, compared with \$310,236, or \$1.72 a share, in the 1951 period.

United States Rubber Co., New York, N. Y. First nine months, 1952: net profit, \$18,912,141, equal to \$2.83 a common share, compared with \$22,428,878, or \$3.51 a share, a year earlier; net sales, \$648,744,964, against \$632,700,279.

Foreign Trade Opportunities

The firms and industries listed below recently expressed their interests in buying in the United States or in United States representations. Additional information concerning each import or export opportunity, including a World Trade Directory Report, is available to qualified United States firms and may be obtained upon inquiry from the Commercial Intelligence Unit of the United States Department of Commerce, Washington, D. C., or through its field offices, for \$1 each. Interested United States companies should correspond directly with the concerns listed concerning any projected business arrangements.

Export Opportunities

Hindi & Co., Khan Quassabieh, P. O. Box 355, Aleppo, Syria: motor vehicle tires.

M.A.P.A., Manufacture Française de Latex Anciens Ets. Wouters & Gillekens, Route de la Gare, Villiers-le-Bel (Seine & Oise), France: latex gloves, toys.

Antonio Godinho & Irmao, Lda., Apartado 389, Luanda, Angola, Portuguese West Africa: bicycles and accessories, including tires.

Rivalland & Son (Pty.) Ltd., 324 West St., P. O. Box 1562, Durban, Union of South Africa: electrical wires and cables.

Import Opportunities

Modelos Especiales, S. de R. L., Medellin 327, Mexico, D. F., Mexico: plastic beach foot-wear with neoprene soles.

Société d'Exploitation des Etablissements Baudouin, Les Eglisottes, Gironde, France: tires for wheelbarrows, hand trucks, and agricultural vehicles; rubber boots for sports, work and industrial uses.

M.A.P.A., Manufacture Française de Latex Anciens Ets. Wouters & Gillekens, Route de la Gare, Villiers-le-Bel (Seine & Oise), France: latex gloves, nipples, fountain pen teats, and toys.

Trade Lists Available

The Commercial Intelligence Division recently published the following trade lists, of which mimeographed copies may be obtained by firms domiciled in the United States from this Division and from Department of Commerce Field Offices. The price is \$1 a list for each country.

Automotive Products Manufacturers: Spain.

Automotive Equipment Importers & Dealers: Panama.

Automotive Vehicle & Equipment Importers & Dealers: Guatemala.

Rubber Goods Manufacturers: Peru.

Tire Retreaders, Recappers, and Repairers: Ecuador.

Dividends Declared

COMPANY	STOCK	RATE	PAYABLE	STOCK OF RECORD
America Hard Rubber Co.	Pfd.	\$0.87 1/2 q.	Dec. 30	Dec. 16
Anaconda Wire & Cable Co.	Com.	2.00	Dec. 17	Dec. 5
Armstrong Cork Co.	Com.	0.50 final	Dec. 19	Dec. 4
Armstrong Rubber Co.	Cl. A Com.	0.50 q.	Dec. 15	Nov. 28
Baldwin Rubber Co.	4 1/4% Pfd.	0.59 1/8 q.	Jan. 2	Dec. 12
Bearfoot Sole Co.	Com.	0.10 extra	Jan. 26	Jan. 16
Canada General Electric Co., Ltd.	* STK.*	0.15 q.	Jan. 26	Jan. 16
Cooper Tire & Rubber Co.	Com.	0.30	Dec. 29	Dec. 15
Crown Cork International Corp.	\$1.00 Cl. A	0.25 extra	Jan. 2	Dec. 22
Dayton Rubber Co.	Com.	0.25 q.	Jan. 2	Dec. 22
Denman Tire & Rubber Co.	82 Cl. A	0.50 q.	Jan. 26	Jan. 9
De Vilbiss Co.	Com.	0.10	Dec. 15	Dec. 1
Dewey & Almy Chemical Co.	Com.	0.30 extra	Dec. 22	Dec. 10
Faultless Rubber Co.	Com.	0.15	Dec. 20	Dec. 10
Firestone Tire & Rubber Co.	Com.	0.25	Jan. 2	Dec. 15
Flintkote Co.	Com.	0.75	Jan. 20	Jan. 5
Garlock Packing Co.	Com.	0.50 extra	Dec. 10	Nov. 25
General Cable Corp.	Com.	0.25 extra	Dec. 29	Dec. 19
General Tire & Rubber Co.	1st Pfd.	0.55	Dec. 19	Dec. 12
Goodall Rubber Co.	3 1/4% Pfd.	1.00 q.	Jan. 2	Dec. 12
B. F. Goodrich Co.	2nd Pfd.	0.50 q.	Jan. 2	Dec. 12
Hewitt-Robins, Inc.	Com.	0.81 1/4 q.	Dec. 31	Dec. 19
Jenkins Bros.	Fdrs.	0.93 3/4 q.	Dec. 31	Dec. 19
Johns-Manville Corp.	Non-Vot.	1.06 1/4 q.	Dec. 31	Dec. 19
Len Rubber & Tire Corp.	Com.	0.15 q.	Feb. 16	Feb. 2
Link-Belt Co.	Com.	0.60 extra	Mar. 16	Mar. 2
Mansfield Tire & Rubber Co.	Com.	0.40 q.	Dec. 26	Dec. 12
Midwest Rubber Reclaiming Co.	Com.	0.25 q.	Jan. 1	Dec. 8
O'Sullivan Rubber Corp.	4 1/2% Pfd.	0.56 1/4 q.	Jan. 1	Dec. 8
Raybestos-Manhattan, Inc.	Pfd.	0.25 q.	Jan. 1	Dec. 15
Seiberling Rubber Co.	Com.	1.50	Jan. 2	Dec. 10
Shellmar Products Corp.	4 1/2% Pr. Pfd.	0.25 q.	Dec. 20	Dec. 5
Thermoid Co.	Com.	1.12 q.	Jan. 1	Dec. 15
U. S. Rubber Reclaiming Co., Inc.	5 1/2% Pfd. A.	1.25 q.	Jan. 1	Dec. 15
Union Asbestos & Rubber Co.	Com.	0.50 q.	Jan. 2	Dec. 15
Viceroy Mfg. Co., Ltd.	Pfd.	0.56 1/4 q.	Dec. 30	Dec. 15
	Com.	0.10	Dec. 31	Dec. 10
	\$2.50 Pfd.	0.62 1/4 q.	Feb. 2	Jan. 12
	Pfd.	0.35 accum.	Dec. 24	Jan. 2
	Com.	0.25 q.	Jan. 2	Dec. 10
	Pfd.	0.15 q.	Dec. 15	Dec. 1
	Stk.†		Dec. 15	Dec. 1

*One full share for each share held.

†One preferred share of \$1 par value for each four common shares held.

Carbon Black Statistics—Third Quarter, 1952

Below are statistics for output, shipments, producers, stocks, and exports of carbon black for the third quarter, 1952. Furnace blacks are classified as follows: SRF, semi-reinforcing furnace black; HMF, high modulus furnace black; FEF, fast extruding furnace black; and HAF, high abrasion furnace black. Statistics on thermal black are included with SRF black to avoid disclosure of individual company operations.

(Thousands of Pounds)

	July	Aug.	Sept.
Production:			
Furnace types:			
SRF	27,581	24,587	25,004
HMF	10,274	11,073	10,467
FEF	13,221	14,552	13,890
HAF	27,602	27,609	31,614
Total furnace..	78,678	77,821	80,975
Contact types.....	46,985	44,329	42,349
TOTALS ...	125,663	122,150	123,324

	Shipments:	Furnace types:
Furnace types:		
SRF	24,877	24,344
HMF	7,409	6,903
FEF	14,616	13,103
HAF	30,335	31,658
Total furnace..	77,237	76,098
Contact types.....	33,899	39,156
TOTALS ...	111,136	115,254

	Exports:	Furnace types:
Furnace types:		
SRF	46,021	46,264
HMF	31,676	35,756
FEF	25,810	27,259
HAF	31,321	28,804
Total furnace..	134,828	136,551
Contact types.....	205,044	213,217
TOTALS ...	342,372	349,768

	Exports:	Furnace types:
Furnace types:		
SRF	7,435	12,210
HMF	13,196	19,652
FEF		14,476
HAF		
Total furnace..	20,631	31,862
Contact types.....		
TOTALS ...	22,951	

SOURCE: Bureau of Mines, United States Department of the Interior, Washington, D. C.

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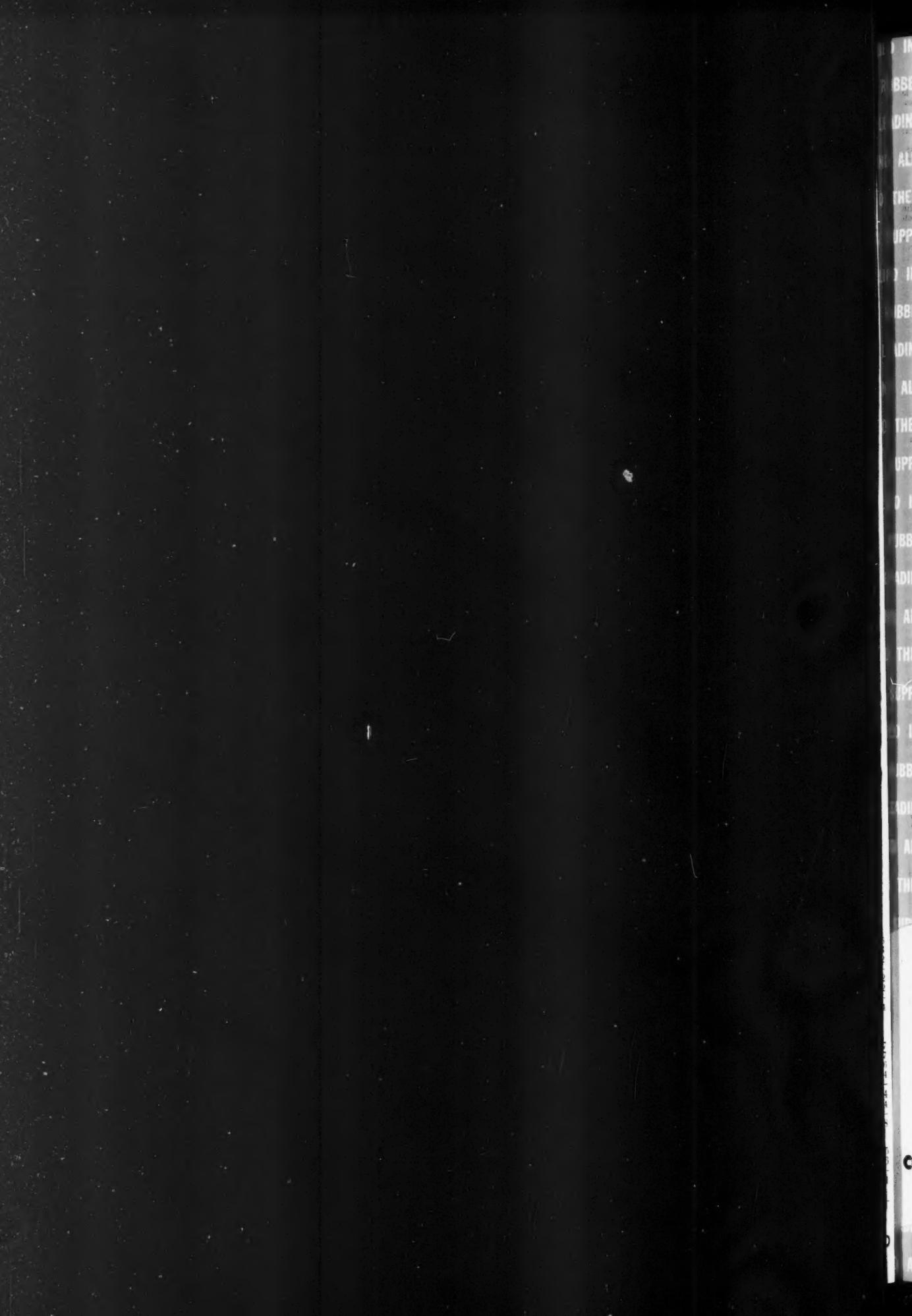
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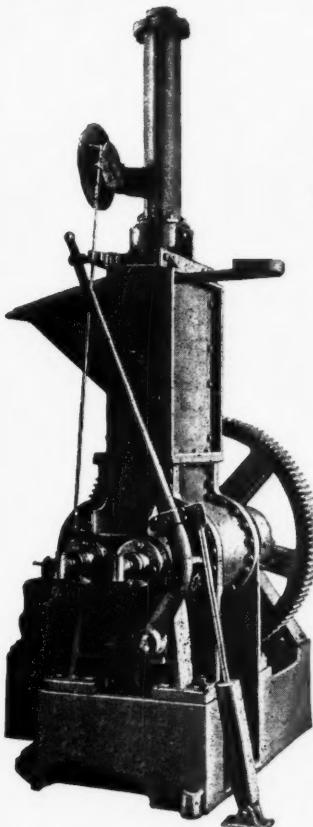
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WORLD





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Banbury Mixers
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CRUDE RUBBER • SYNTHETIC RUBBER • SCRAP RUBBER • HARD RUBBER DUST • PLASTIC SCRAP

Fidelity KNIT METHOD OF HOSE REINFORCEMENT

offers you all these advantages...

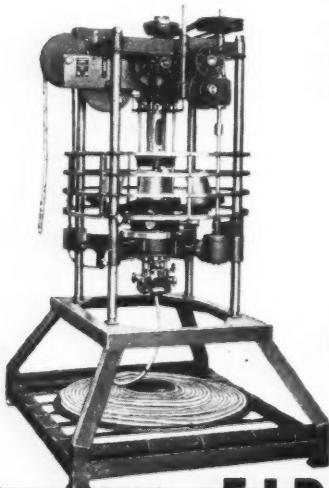
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- **300% faster production**
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- **500% greater labor efficiency**
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- **90% less down time**
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The Fidelity Knitter uses untreated rayon, cotton, nylon, fiberglass, etc. as purchased, eliminating costly treating and rewinding equipment. Only 4 yarns to tend, save time and give consistent hose diameters. No drying time after knitting.

Results—a finer, more flexible hose with better adhesion, at a lower cost than braided hose.

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FIDELITY VERTICAL HOSE
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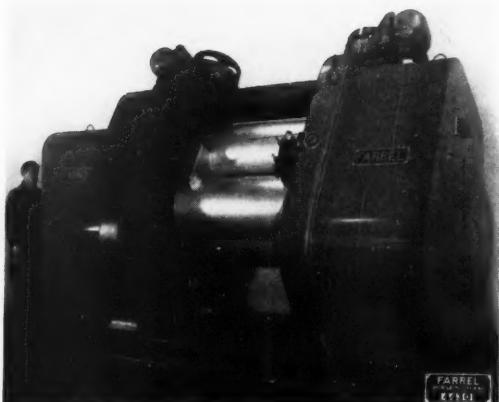
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Manufacturers of intricate precision machinery since 1911.

New Machinery



Farrel-Birmingham Three-Roll Tri-Angular Calender

Three-Roll Calender

A NEW three-roll Tri-Angular calender, available in a range of sizes and optional features to handle any calendering process requiring two passes, has been announced by Farrel-Birmingham Co., Inc., Ansonia, Conn. The calender features a right-angle arrangement of the three rolls which isolates the separating forces. With only two rolls in any plane, there is no pressure from a third roll to affect roll settings and cause gage fluctuations. Hydraulic pull-back cylinders hold the rolls in their operating positions, eliminating backlash in the boxes and adjusting screws.

The angular roll arrangement also improves feeding conditions, since the angle of the rolls provides better support to the feed bank, and bank and guides are easily accessible from the floor level. Standard units are furnished with mechanical lubrication, but a flood lubrications system can be provided for high-temperature operation. Other optional features include rolls drilled longitudinally beneath the working surfaces for more effective temperature control; a motorized crossed-axes device for fine adjustment of roll crown on the gaging pass; and the company's Uni-Drive mechanism. This drive system separates the drive and connecting gears from the calender and encloses them in a separate housing from which they are connected to the calender by universal spindles. The Uni-Drive reduces gear maintenance and provides efficient power transmission under varying torque loads.





HOW TO CUT COSTS ON { **LOW TEMPERATURE LOW VOLUME SWELL**

Plasticizers

Ricinoleates are fully equivalent and, in many cases, superior to the commonly used low temperature plasticizers. An added feature is their extremely low volume swell in aromatic fuels. Their cost is much lower. Check this graphic comparison and you will see that costs can be cut substantially.

Baker Ricinoleate Esters:

PG-16, Butyl Acetyl Polyricinoleate

25% Nitrile Rubber

FLEXRICIN® P-4, Methyl Acetyl Ricinoleate

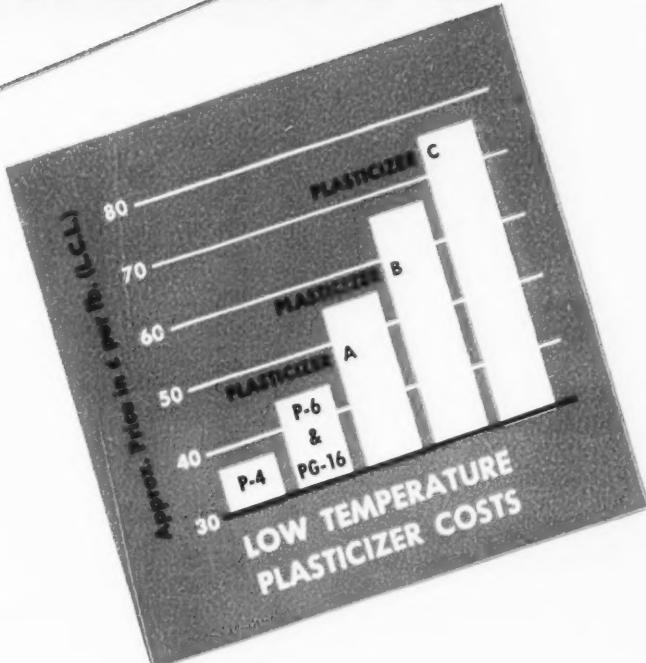
40% Nitrile Rubber

FLEXRICIN P-6, Butyl Acetyl Ricinoleate

Neoprene GN

FLEXRICIN P-4, Methyl Acetyl Ricinoleate

GRS



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PG-16 P-4 P-6
 Technical Data

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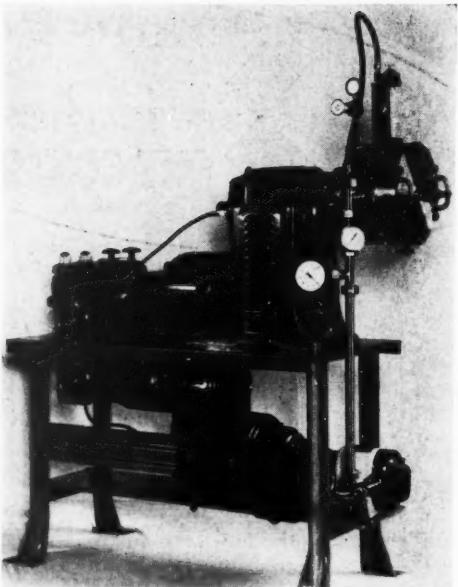
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ESTABLISHED 1903

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FOR DEPENDABLE SERVICE ON ALL YOUR RUBBER REQUIREMENTS

WORTH 4-1460



Model 10M-3 Oakes Continuous Automatic Mixer

Latex Foam Mixer

A SMALLER version of its continuous automatic mixer, used successfully in the manufacture of latex foam, has been developed by E. T. Oakes Corp., Islip, N. Y. Designated the Oakes Mixer Model 10M-3, the new unit operates on the same principle as the older Model 14M-5, but has a smaller capacity. The large mixer is rated at a maximum capacity of 1,800 pounds of wet latex an hour; whereas the new Model 10M-3 has a capacity of 150-190 pounds an hour. Where required, the new mixer can operate at capacities down to 50 pounds of wet latex an hour.

The mixers are said to eliminate 12-15% of the waste resulting from batch mixing processes and also permit injection molding of foam latex in closed molds. Both the large and the small mixers feature self-contained power units for the mixing rotor and pump drive, wide speed range, and ease of adjustment to handle latex densities down to a specific gravity of 0.06. All necessary controls, instruments, proportioning pump units for slurry, and other fittings are incorporated in each model.

Vibrating Screen

A NEW-STYLE vibrating screen for sizing and processing chemicals, ore, and other bulk materials has been announced by Hewitt-Robins, Inc., Stamford, Conn. Known as the Robins Vibrex, Model MS, the screen will handle heavier loads than previous models, is equipped with a heavier yoke, and is mounted on coil springs instead of the leaf springs formerly used. The springs are encased in neoprene accordion-type boots to keep out dirt.

The screen employs the company's circle-throw principle which gives two positive strokes with every revolution of the counterweights. These strokes bounce the material out of and above the screen cloth. At the same time a circular action is imparted to the material particles, making them rotate as

(Continued on page 566)



Robins Vibrex Model MS Vibrating Screen

Oronite POLYBUTENES

economical extenders of rubber



Oronite Polybutenes are clear, light colored, chemically stable liquids of moderate to high viscosity and tackiness. They have excellent aging characteristics. They do not become gummy or waxy, do not harden, darken or change in any essential property over long periods of atmospheric exposure. They can be readily emulsified using standard techniques and equipment.

Polybutenes can be used as a rubber extender in the manufacture of a wide variety of molded rubber products such as rubber boots, garden hose, hot water bottles. Besides extending rubber, Polybutenes plasticize the mass of rubber making it more pliable for easy milling.

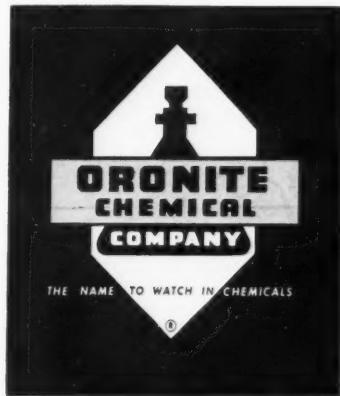
Oronite Polybutenes are used in milling reclaimed rubber batches and have a field of usefulness in plasticizing various synthetic rubbers.

Oronite Polybutenes are available in four grades, based on viscosity. Complete information is available in a technical bulletin.

*Write or phone the Oronite office nearest you
and talk over your problem with us.*

ORONITE CHEMICAL COMPANY

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MERCANTILE SECURITIES BUILDING, DALLAS 1, TEXAS



2630

KAMLOK
COUPLING ASSEMBLIES

The
Fastest. Surest
Coupling Known.

KAMLOK Couplings combine speed, perfect performance, durability—three features that are indispensable. Fastest! Perfectly tight, safe connection in seconds, by sliding coupler over adaptor, and pressing cam levers. KAMLOKS couple and uncouple instantly, regardless of "hookup." Efficient! No wasted time—effort, achieving leakproof-tight connection that guarantees consistently safe operation at peak efficiency. Long-lasting! Made of hard wear-resistant bronze to 3". 4" size of OPALUMIN, as strong as bronze, only $\frac{1}{2}$ the weight. KAMLOKS add extra life to hose.

Write for Bulletin F-3

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VALVES, FITTINGS, ASSEMBLIES
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THE SOURCE FOR EVERY GRADE

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Magnesium Oxides for Neoprene Compounding
Valencia Pumice
Elk Brand Antimony Oxide
for Flame-proofing. Stearates: Zinc & Calcium
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RUBBER MATERIALS DEPT A
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Richardson Agencies, Ltd. 454 King Street W., Toronto

New Materials

Fortex—New Reinforcing Agent

FORTEX, a new multi-purpose rubber reinforcer, extender and processing aid is offered by Thermod Chemical Co., Trenton, N. J., through the sales agent, Herron Bros. & Meyer, Inc. The first of a series of rubber chemicals to be offered by Thermod, Fortex is a non-toxic, non-volatile brown liquid which pours easily, when warmed, and can be used in processing natural, reclaimed, and all synthetic rubbers except butyl and polysulfide.

The new material reinforces rubber by increasing tensile strength, modulus, and hardness and also improves tear resistance, resilience, and age resistance. In processing, Fortex acts as a plasticizer and anti-crosslinking agent. Production experience in Thermod plants during the past several months indicates that the product should be added directly to the rubber early in pre-breakdown or at the start of milling in order to gain full advantage of its properties. It is not volatile and is present in the final rubber compound. As a dispersing agent, Fortex permits high carbon black loadings at lower temperatures and aids in the incorporation of pigments. Fortex can be used in white and colored compounds and can replace all or part of the stearic acid in a recipe.

New Synthetic Wax

A LCOWAX, a new low molecular weight, wax-like material derived from ethylene, has been announced by Semet-Solvay Division, Allied Chemical & Dye Corp., 40 Rector St., New York 6, N. Y., marking the Division's entry into the petrochemical field. The new product is being made on a small scale at Buffalo, N. Y., pending completion of a new full-scale plant at the same location later this year.

Available in two grades differing in hardness, Alcowax has wax-like hardness and a melting point of approximately 100° C. The product is a translucent white in color, tasteless, non-toxic, and substantially odorless. It has low density, excellent electrical properties, and is compatible with most waxes and wax-like materials. Its water resistance and anti-blocking characteristics suggest use as a separator or dusting agent for stacking sheeted rubber. Other suggested applications include coatings, electrical insulation, inks, polishes, and cosmetics. A modification, Alcowax M, is readily emulsifiable and should find use in latices for paints, textiles, and paper.

Piccopale — New Hydrocarbon Resin

P ICCOPALE, a new hard hydrocarbon resin produced by the polymerization of unsaturates derived from the deep cracking of petroleum, is available in commercial quantities from Pennsylvania Industrial Chemical Corp., Clairton, Pa. The 100% polymerized resin is a clear, transparent thermoplastic having good chemical resistance, ready solubility, and compatibility with a wide range of products, it is claimed. The resin is available in the following four standard grades: Piccopale 100, a flaked or solid material with a melting point of 100° C.; Piccopale 85, a solid with a melting point of 85° C.; Piccopale 70, a solid with a melting point of 70° C.; and Piccopale 100 Solution, having 60% solids in mineral spirits.

The resin is also said to have cost-saving and product-improving characteristics in rubber, plastics, petroleum, leather, stone, clay, glass, chemical, textile, floor covering, paper, and other industries. Piccopale is compatible with rubber polyethylene, waxes, coumarone-indene resins, phenolics, rosins and esterified rosins, many alkyls and vinyls, and most drying oils. Uses in the rubber industry include softeners, tackifiers, compounding aids, reclaiming agents, and dispersing aids.

"*Witco Dibutyl Adipate.*" Technical Service Report E-5. Witco Chemical Co., 295 Madison Ave., New York 17, N. Y. 1 page. Data are given on the properties and composition of the company's dibutyl adipate, an ester-type plasticizer for a wide variety of synthetic resins.

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New Goods

Farm Implement Tire



New Goodyear Press Wheel Tire and
Tire Cross-Section

The tire is semi-pneumatic, however, since small vents at the bottom of the casing force air in and out, permitting the tire to "breathe" as it rolls. The rubber tires do not require wheel scrapers which frequently trap dirt and stick; these tires also give better flotation in loose soil because of the closed center. The press wheel tire is made in 6 x 16, 6½ x 12, 6½ x 20, 7 x 18, and 8 x 30 sizes; while the gage wheel unit is made in 2 x 13, 3½ x 12, 4 x 16 sizes.

Wire Brush



Hewitt-Robins Wire Brush
with Replaceable Filler

A NEW wire cup brush with replaceable filler has been developed by Hewitt-Robins, Inc., Buffalo, N. Y., for the removal of rust, scale, paint, and welding slag from tanks, gears, and other metal surfaces. An addition to the company's Rubberlok line, the brush consists of inner and outer metal adapters with a replaceable cup shaped filler in which the wire bristles are anchored in place with rubber. The brush also features improved balance, shock absorption, and bristle retention and will be available in wire gages ranging from 0.014-0.028-inch.

New Fabric Material

LIGHTWEIGHT, tear resistant tarpaulins for trucks and boats, and other applications are foreseen by United States Rubber Co., Rockefeller Center, New York 20, N. Y., for its new Fiberthin fabric. A patent on Fiberthin base fabric and coated fabric was granted early in December to B. H. Foster, of the company's general laboratories, and assigned to U. S. Rubber. Claims were allowed on both the special gray goods used and on the coated product.

Fiberthin base fabric is a thin, flexible material woven of

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Moe Muscles knows how easy it is to handle bags properly treated with Dow Corning Emulsions. They slip smoothly into place and they come out without sticking. Same's true when he gets green carcasses treated with a solvent solution of Dow Corning Mold Release Fluid and talc.

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Silicone treated bags, like silicone lubricated molds stay in service longer. You get easier release of more accurate and highly finished tires free from blemishes inside and out. That's why most rubber companies here and abroad specify Dow Corning silicone mold release agents; emulsions for curing bags and molds; fluid for green carcass, bead and parting line release.

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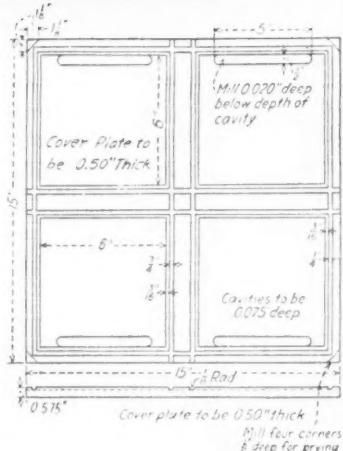
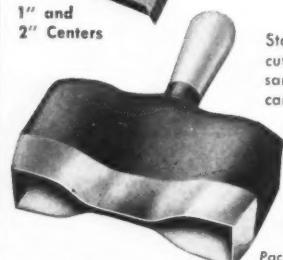
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flat, ribbon-like, continuous multi-filament yarns such as nylon, orlon, and rayon. It can be combined with coatings of natural or synthetic rubber, or plastic. Because of its unusually high tear resistance in proportion to its weight, this fabric has been used for many military applications, including airplane wing covers, tarpaulins, and other protective coverings. Widespread use is also anticipated in civilian applications requiring a waterproof fabric of light weight and high tear and snag resistance. The base fabric and coated fabric will be produced by weavers and coaters under license by U. S. Rubber.

New Snow Tire

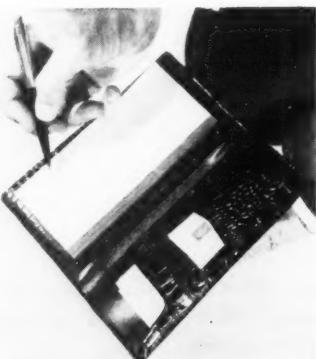


Firestone's New Town & Country
Snow Tire

tread elements which assure safer stops and sure starts.

The continuous tread design formed by the interlocking non-skid bars are said to give the new tire a quietness and smoothness of operation never before achieved with a traction-type tire. Objectionable vibration, rumble, and whine are claimed to be eliminated by Town & Country. In addition, the wide, flat tread is claimed to provide much longer mileage than other winter-type tires. The white sidewalls of the new tire are protected from scuffing by a circumferential rubber curb guard. The new tire are available in sizes to fit all popular-make automobiles.

Embossed Vinyl Accessories



Vinyl Wallet with Embossed Alligator Finish

made in two sizes, contains a handy memo pad, a large compartment for papers or currency, a card pocket, an extra compartment for comb or pencil, and a hidden money section. The billfold's one-piece fold construction features two hidden compartments, four card pockets, and a money compartment. The key case has removable holders for six keys and also provides a compartment for a driving license. Billfolds, wallets, and key cases are available in black Morocco, red lizard, and brown alligator finishes.

VINYLITE plastic sheeting embossed with Morocco, lizard, or alligator leather textures is used in a new line of billfolds, wallets, and key cases made by Autopoint Co., Chicago, Ill. Designed as personal accessories for remembrance advertising, each item can be supplied with embossed or printed names or sales messages. The seams are all electronically sealed and smooth edged, and the plastic is flexible, abrasion resistant, and easily cleaned with soap and water.

The fully lined wallet, made in two sizes, contains a handy memo pad, a large compartment for papers or currency, a card pocket, an extra compartment for comb or pencil, and a hidden money section. The billfold's one-piece fold construction features two hidden compartments, four card pockets, and a money compartment. The key case has removable holders for six keys and also provides a compartment for a driving license. Billfolds, wallets, and key cases are available in black Morocco, red lizard, and brown alligator finishes.

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PLASTOLEIN 9058 DOZ—(di-2-ethylhexyl azelate)—a good all around basic plasticizer that also imparts excellent low-temperature properties. Its outstanding combination of properties leads to its use in any vinyl product. Also advantageous for nitrile and GR-S rubbers.

PLASTOLEIN 9055 DGP—(diethylene glycol dipelargonate)—a general purpose auxiliary plasticizer for imparting low-temperature flexibility, excellent "hand" and drape to vinyls. Also, an outstanding low-temperature plasticizer for Neoprene and Buna-N rubbers.

PLASTOLEIN 9250 THFO—(Tetrahydrofurfuryl oleate)—a fatty type plasticizer of unusual stability, providing internal lubrication for superior processing. Also imparts excellent "hand" and drape to vinyl films and sheeting. Its relatively low cost makes it attractive for cellulosics, particularly nitro-cellulose, and synthetic rubbers.

PLASTOLEIN 9715, 9720 POLYMERIC—These Polymeric Plasticizers impart extreme durability and weatherability to vinyl materials, yet exhibit the low-temperature characteristics and high efficiency of most monomeric plasticizers. Prolonged exposure to heat and ultraviolet light does not result in appreciable discoloration, stiffening, or sweat-out.

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MALAYA

Revising T. C. R. Methods

The Rubber Research Institute has begun to publish a new series of the *Planters' Bulletin*. The earlier series, started in 1938, had to be discontinued after the issue for November, 1941.

In view of the growing importance of technically classified rubber (of which, by the way, Malaya is the biggest producer), No. 2 of the New Series, for September, 1952, contains two articles on the subject, one giving a general picture of the situation, and the other detailing procedure for estates.

From the first of these two articles it is learned that the Rubber Research Institute has been investigating the possibilities of producing T. C. Rubber from the output of packing houses and from remilling factories—that is, of the lower grades of rubber so largely used by the big tire manufacturers. As far as packing houses are concerned, classification was found practicable; only a comparatively small modification to the packing procedures was required.

The consumer demand for T. C. Rubber has been considerably in excess of supply, and all grades have been sold to a large extent independent of the particular classification. But, as was foreseen by the RRI, manufacturers are now beginning to ask for specific grades to suit their particular methods of compounding and processing, and experiments have been conducted on estates aiming at modification of the physical properties of the rubber produced by slight alterations in estate procedure and small, innocuous additions to the latex. Results indicate that it may be possible in the future to produce "made to order" rubber, so to speak, and thereby considerably improve the competitive position of natural rubber with regard to synthetic.

Further developments are reported by R. G. Newton, coordinating officer of the International Rubber Research Board, who paid a seven-week visit to six producing areas in southeast Asia in the latter part of 1952. What he saw led him to conclude that the 1952 output of T. C. R. should be in excess of 20,000 tons; an estimate for 1953 could not be given, but he foresaw very favorable prospects for the year ahead.

He stated that the IRRB had agreed to delete the Mooney classification as from December 31, 1952, since it obviously was not proving useful to consumers. In 1953, therefore, there will be only three technical classes instead of nine—red, yellow, and blue circles. Evidence further indicates that high-elongation tests are unsatisfactory, and low-elongation testing at test stations is being encouraged.

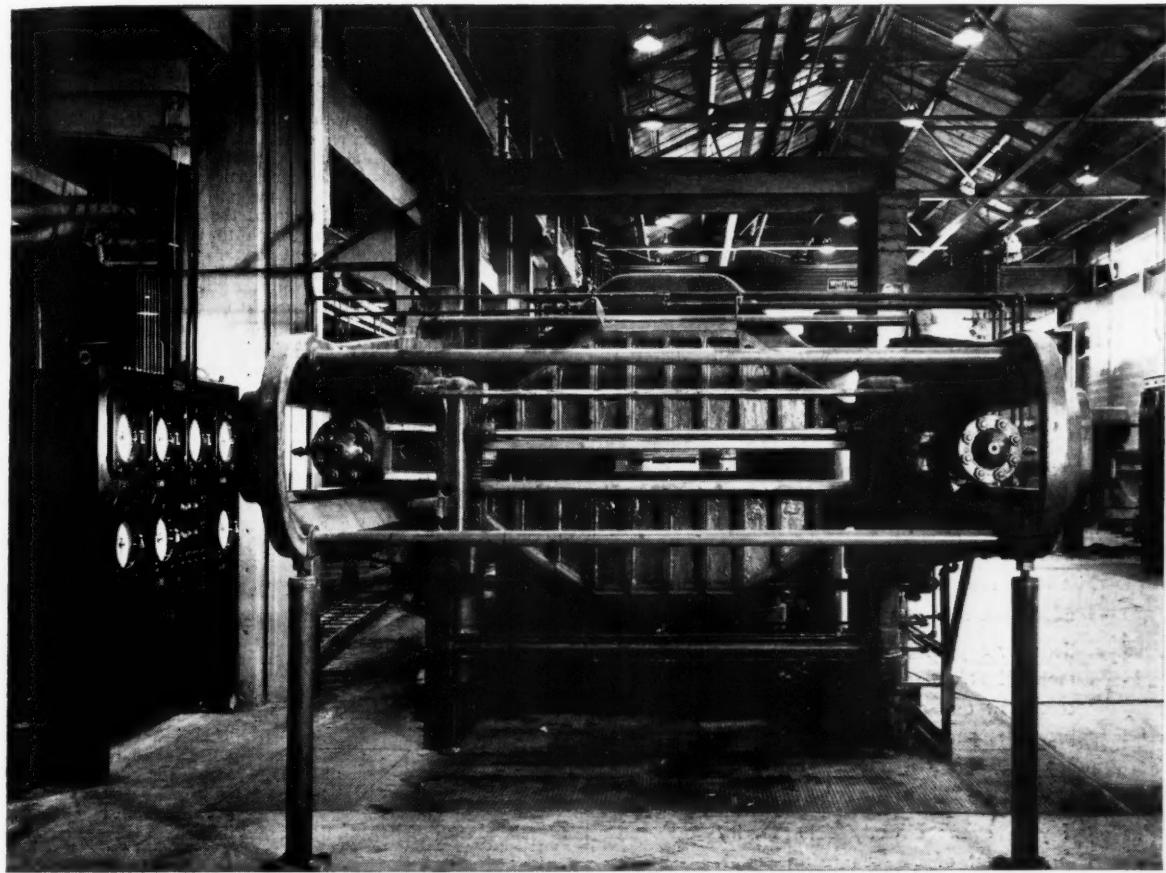
The introduction of a test measure rate of cure, Mr. Newton found, would involve procedures which would be excessively time- and labor-consuming and hence would not be welcomed in Malaya. He, therefore, suggests that for the present the best technique to examine would be a method based on two cures, probably with an assumed value for the Mooney viscosity of the stock.



Job to Do?

SEE PAGE 442

BIG BELT...TINY WASTE!



THIS 78" x 35' 8" Belt Press, made by Farrel-Birmingham Company, Inc., and installed in the Buffalo plant of Hewitt-Robins, Inc., is one of the biggest at present in operation in the U.S.A.

Hewitt-Robins have been using Taylor instruments to control temperature and timing of the cure of their vulcanizing presses for many years. Here's what happens on this mammoth press: Taylor FULSCOPE* Controllers control the steam heating of the platens and the condensate, the cooling of the platens, the temperature of the water-cooled ends and the duration of the cure.

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Latex Symposium

In Communication 276 (December, 1951), which has recently come to hand, the *Journal of the Rubber Research Institute* publishes the proceedings of the latex symposium held at the Rubber Research Institute of Malaya, February 19-21, 1951. Representatives of the principal rubber research institutes in Europe and the Far East were present, and 32 papers covering the physiology, chemistry, and technology of latex were read.

The RRI director C. E. T. Mann, opened the symposium with an introductory review in which he pointed to the change in the postwar trend in rubber research in the Far East induced chiefly by the threat of American synthetic rubber. Where emphasis before the war had been on improving the quality of the planting material and of reducing costs through improved methods of production, today it was chiefly the quality of the product in comparison with synthetic rubber that was under consideration, and research effort was largely directed to discovering the fundamental properties of rubber and latex and to improving and modifying these properties.

The papers presented under the physiology section of the symposium probably best illustrated the new trend, in this instance exemplified by the approach to the problem of yields. In his paper on "Latex and Growth," J. Schweitzer, of the Association of Central Experiment Stations (C.P.V.) at Bogor, Indonesia, called attention to the presence in latex of organic intermediates which may be used by the tree for rubber synthesis; he also pointed out that the important results obtained by Bonner and others at the California Institute of Technology, with radio-active carbon in guayule investigations, supported the view that the precursors of rubber originate from the intermediates of carbohydrate metabolism.

G. W. Chapman, of the Chemara Central Research Station, Malaya, was able to show that increased yields could be obtained by periodic treatment of the bark of Hevea with synthetic hormones in a palm-oil base. The use of the synthetic hormone, however, was not without some less desirable results: necrosis of the bark was observed and late dripping; the latter suggested that the increase in yield might be due rather to more rubber being drawn per tapping than to an increased rate of rubber synthesis.

P. Tixier, of the Rubber Research Institute of Indo-China, carried out experiments on the injection of trace elements, especially copper in the form of sulfate, into *Hevea* trees. He found that this treatment increased production of rubber up to about 60%; however, results varied considerably according to the plant material used and even the same clones, in different locations, reacted differently to the injections. Indications were found which suggest the possibility that treatment with copper sulfate might perhaps be a means of curing trees affected with brown bast. The D.R.C. of latices from injected trees is lower and nitrogen content slightly higher than for untreated trees. Rubber from such latices showed a significant increase in modulus and lower Mooney viscosity. The modulus increase is correlated with the D.R.C. decrease and nitrogen content increase.

Papers dealing with the chemistry of latex centered largely on the factors affecting the stability of latex, and it seemed to be the opinion that the yellow fraction of latex is of great importance to latex stability.

Among the papers under the latex technology section, was one by J. H. Pidford (H & C Latex, Ltd.), in which a practical test is described which measures the critical gelling temperature of a latex-zinc oxide mix under standard conditions as an index of stability. G. M. Kraay and M. van den Tempel (Rubber Strichting, Delft, Holland) had a paper on the mechanism of gelation of ammoniated latex in the presence of zinc oxide, showing that of themselves zinc ammonium complexes have no coagulating power, but, when heated, zinc ions split off which form insoluble zinc soaps in the latex, resulting in gelation or coagulation.

Shipping & Packing Ordinance Protested

Chinese rubber dealers and packers held protest meetings early in November against the Rubber Shipping & Packing Control Ordinance. It was claimed that this ordinance would cause the rubber industries in Indonesia and Thailand to bypass Singapore when rubber was being shipped overseas. The packers asked for some form of protection to be included in the ordinance which would tend to give confidence to the Malayan rubber industry. A spokesman was chosen to present the views expressed to the proper authorities.

The attitude manifested toward the ordinance in Singapore surprised Stanley F. Ward, a well-known London rubber dealer who was visiting Malaya toward the end of last year. He warned that bad Malayan shipments were giving Malaya a bad name and reportedly stated that the Ministry of Materials in

London had so much difficulty with inferior rubber shipments that it now refused to accept such shipments, and ordered sellers to replace them with others of the required quality within two months. Mr Ward suggested the setting up of an international panel of experts to work closely with the Malayan Rubber Export Registration Board, a disciplinary body acting under the new ordinance. He added that experts in New York and London should, if necessary, make personal investigations of complaints, the expense involved to be charged to guilty shippers. He also took the opportunity to warn that for the time being, at least, it was not in Malaya's interests for rubber prices to increase above the prevailing level.

Amalgamations

Negotiations have been announced regarding two important mergers of rubber companies involving more than 45,000 acres of land. All the estates, which are European owned and managed, are in the Harrisons & Crosfield group. The companies concerned in the larger merger are Pataling, Anglo-Malay, and Bikam. Together they have 12 plantations with a total area of 25,373 acres; their combined capital is \$11,000,000 (Straits), and net liquid assets are \$13,000,000. It is rumored that still another company of the above-mentioned group may also be included in the merger.

The parties in the second amalgamation are Golden Hope Rubber Estates, Ltd., and Lumut Rubber Estates, Ltd., who together own nine plantations covering 19,893 acres. The present issued capital of Golden Hope is £410,330 and of Lumut, £487,632.

The advantages expected from the combines are that they will facilitate programs of rejuvenation and redevelopment; overhead charges would be reduced, and financial and other resources pooled; finally, the units involved are scattered throughout the Federation, and the mergers will bring them under joint control.

Wage Agreements

The wage talks which had reached an impasse in September, leading the government to intervene and appoint a board of arbitration, have finally been peacefully ended, though even at the last it seemed likely for a time that all efforts at agreement would fail again. The arbitration board had published its award, which gave the workers 20-25 cents (Straits) a day more than employers had declared themselves ready to pay after the wage talks collapsed last September. The award was joyfully accepted by the workers and apparently also by the employers. It later developed, however, that what the latter had agreed to was not the rates as published by the arbitration board, which, it seems, were based on an erroneous calculation of the cost of living allowance, put at 105 cents a day, but the rates based on the correct allowance of 95 cents a day. This meant a cut of 10 cents a day in the pay of the worker, and for a time it was feared that the dispute between labor and employers would start all over again. The cut, however, was finally agreed to because, as the spokesman for labor said, the unions did not wish to do anything to endanger industrial peace or to hinder the speedy ending of the emergency, but their future policy would be planned with the lessons that were learned in the dispute kept in mind.

The corrected daily wage rates follow. When the price of rubber per pound is between 80 and 90 cents (Straits): \$3.15 for contract tapper; \$2.75 for checkroll tappers; \$2.20 for field workers. At a rubber price between 70 and 80 cents, the rates are \$3.10, \$2.65, and \$2.20 respectively; at a price between 60 and 70 cents the respective rates are \$2.80, \$2.60, and \$2.10.

Cyclized Rubber Trials

Equipment recently was brought to Malaya for the local production of cyclized rubber from latex on an experimental scale. E. P. B. Edwards, a technologist of Rubber Technical Developments, Ltd., England, who is setting up the plant at the Rubber Research Institute Station at Sungai Buloh, not far from Kuala Lumpur, revealed that this step has been taken to determine whether it is more economical to make the cyclized rubber in Malaya than in England. This new type of rubber, Mr. Edwards reportedly explained, is a potential competitor of American synthetic soling material now widely used.

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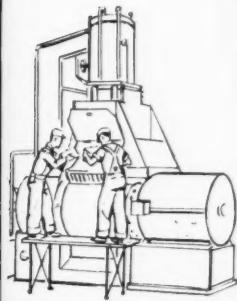
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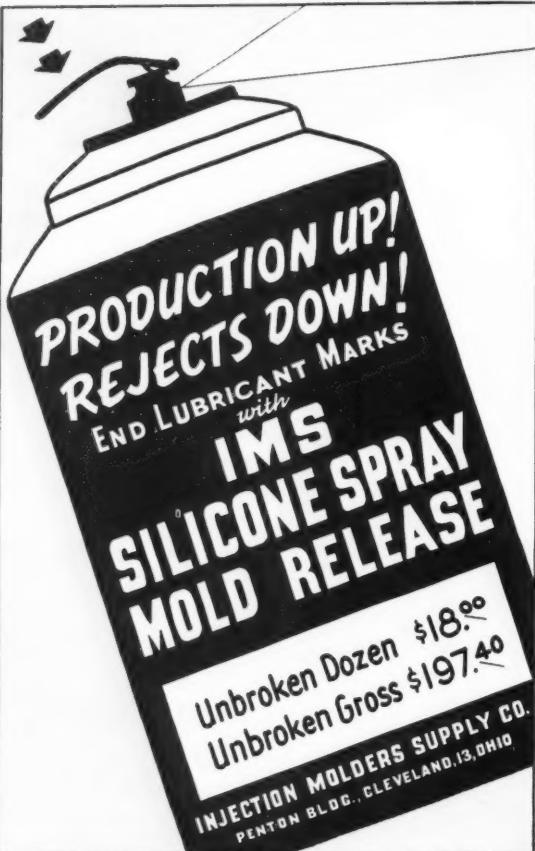
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CEYLON

According to customs returns, Communist China bought 46,000,000 pounds of rubber from Ceylon up to October 1952, paying in all more than 93,000,000 rupees.

Since then a long-term trade agreement between the two parties has been made whereby Red China is to buy from Ceylon 50,000 tons of rubber a year for five years at a price above the average Singapore price. For the first year the rate will be 10d a pound above world price. The price for subsequent years is to be negotiated every year. In return, China is understood to have agreed to supply Ceylon with 200,000 tons of rice a year. This amount of rice has now been found inadequate; so toward the end of 1952 a Ceylonese delegation proceeded to Peiping in order to ask China to increase rice shipments to 300,000 tons a year.

Rumors are afloat to the effect that the Chinese have been attempting to arrange for an exchange of goods, including rubber, on similar lines, with Indonesia and Thailand. In this connection news from Bangkok, Thailand, states that an adviser to the Siamese Department of Agriculture has proposed a plan for a rubber cartel to increase prices. He reportedly intimated that he had discussed such a plan in Singapore with representatives of other rubber-producing countries.

INDIA

*Indian Rubber Bulletin*¹ learns that the Government of India is considering the possibility of developing rubber planting in the Andaman Islands. It seems that around the beginning of the century, rubber had been grown experimentally by the Government Forest Department on one of the islands, which then leased the plantation to a firm in Burma that continued cultivation there until the Japanese took over during the late war. In the reported development scheme, this plantation would form the nucleus of a large-scale rubber growing experiment. South India planters are to be encouraged to take up land, on favorable terms, on the Baratton Island, which has an area of roughly 80 square miles.

In a recent article² on chlorinated rubber and its applications, M. R. A. Rao and G. S. Rama Iyer, of the Indian Institute of Science, Bangalore, describe a process for the direct chlorination of latex as developed at that Institute.

"Rubber latex is shaken up with carbon tetrachloride to give an emulsion which is mixed with suitable catalysts and stabilizers. The charge is kept in a reservoir and passed down a chlorinating column wherein it comes into intimate contact with an upward stream of chlorine. The chlorinated rubber solution collects in a vessel at the bottom of the column and can be discharged at intervals. Complete chlorination is insured by making the chlorine inlet dip in the chlorinated solution in the bottom vessel. The dissolved chlorinated rubber is precipitated by discharging the solution into hot water. The carbon tetrachloride is recovered by distillation. The precipitated chlorinated rubber is washed thoroughly and dried."

By this method, it is added, complete chlorination takes about 2-4 hours.

Dunlop Rubber Co. (India), Ltd., reported net profit of 10,790,000 rupees for the past business year, against 9,000,000 rupees the year before. Sales were about 71% higher than in 1950; however, because of the increase in issued ordinary capital, dividend was fixed at 15% instead of 20%, as in the preceding year. Sales were helped by the introduction of new bus and truck tires in 1949 and of new car tires in 1950. The addition of Dunlopillo latex foam products to the range of goods made at the Shahgani Works is expected further to stimulate developments in India.

¹June, 1952, p. 20.
²*Rubber India*, Apr., 1952, p. 5.

BURMA

On September 17, the Minister of Industries & Mines, U Kyaw Myint, told Parliament that Burma is considering whether to sell her rubber to China or elsewhere to secure better prices. Answering a questioner, he stated that the government was aware of the drop in rubber prices. Though many rubber estates in Burma are still under rebel control, the country's output in 1951 was 22,000,000 pounds.

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SOUTH AFRICA

The import controls imposed by the Government of the Union of South Africa on various articles including rubber goods have apparently been working to the satisfaction of many local manufacturers whose products have thus had a chance of becoming more widely and favorably known here.

By all accounts, activity in the South African tire industry reached a relatively high level last year and continued unabated, at least through the first half of 1952. Supplies of raw materials are said to have been adequate; shortages in some lines, which for a time interfered with output in some directions, appear to have been largely made up; thus the manufacture of white-walled tires, which had to be suspended almost a year for lack of titanium oxide and other necessary chemicals, has lately been resumed in the Port Elizabeth area. Imports of certain ingredients will have to be substantially increased to meet the growing demand of the expanding industry. Consumption of carbon black, for instance, at 16,175,150 pounds in 1951, is expected to be much higher in 1952. Rising prices of raw materials, however, created their own difficulties, as company reports reveal.

Dunlop (S.A.), Ltd., reported record volume of business in 1951, but net profits, after taxation, declined to £275,008 from £340,453 in the preceding year.

The Goodyear Tire & Rubber Co. (S.A.), Ltd., made net profits of £330,923 in 1951. The preferred dividend was paid, but the need of additional working capital during the year—largely due to increased prices of raw materials—precluded the distribution of a common stock dividend.

This company is expanding plant to meet the growing market for its products, which include mechanical rubber goods for the local mining industries. Recently Goodyear completed—as a special order for a newly opened gold mine—the heaviest single conveyor belt it has ever made. Goodyear has also been manufacturing rubber linings and other rubber parts for uranium mining pumps for a concern in the Johannesburg area in the Transvaal, which proved so satisfactory that many more orders for these types of goods are to be expected.

The General Tire & Rubber Co. (S.A.), Ltd., showed net profits of £84,725 in 1951, against £69,442 for 1950. Dividend was maintained at 4½ per share. In discussing the results of his company in 1951, the chairman stated that the price of raw materials had risen by 190% from 1949 to 1951 whereas the price of tires rose by only 55% in the same period. This company has been able to increase output by 50%.

Expansion is reported also in some other branches of the rubber and allied industries, particularly in toys. Vulco Chemical Co., Ltd., Johannesburg, which makes a wide variety of toys from rubber latex, increased its floor space to meet greater demand not only for home consumption, but lately also for export.

Various firms are producing plastic toys and novelties, which in many cases are said to be low-priced. The latest company to join the ranks is Plastic (Pty.), Ltd., Johannesburg.

SPAIN

The first Spanish Plastics Conference and Exhibition, organized by the comparatively recently formed Spanish Plastics Institute, was held in Madrid from May 10-17. All the important producers of plastic materials and the converters were represented at the exhibition, but no foreign firms, except the Swiss Ciba concern and Imperial Chemical Industries, Ltd. The exhibition was reportedly attractive enough and presented a fairly wide range of technical parts, toys, notions, and household goods, with special emphasis given to polyacrylate-based articles.

The conference, devoted chiefly to short reports and discussions, concentrated mainly on standardization and testing, training technologists, and raw materials. Longer papers were presented by various foreign visitors and included:

"Standardization and Testing of Molding Materials," by P. Dubois, Paris, France.

"Economic Aspects of the Plastics Industry," H. Frank, Delft, Holland.

"Polymerization and Condensation Problems," H. W. Melville, Birmingham, England.

"New Developments in Epoxylin Resins," E. Preiswerk, Basle, Switzerland.

"Importance of Research for the Development of the Plastics Industry," R. Vieweg, Braunschweig, Germany.

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Editor's Book Table

BOOK REVIEWS

"**Styrene, Its Polymers, Copolymers, and Derivatives.**" Edited by Ray H. Boundy and Raymond F. Boyer, assisted by Syvia M. Stoesser. American Chemical Society Monograph Series, No. 118. Reinhold Publishing Corp., 330 W. 42nd St., New York 36, N. Y. Cloth, 6 by 9 inches, 1,326 pages. Price, \$20.

Here is the definitive and comprehensive treatment of present-day knowledge on styrene polymers, copolymers, and derivatives. Starting with a history of styrene monomers and polymers, the book covers manufacturing methods, properties, methods of handling and analysis, styrene chemistry, theory and practice of polymerization, and fabrication of polystyrene. Where the literature on the subject is contradictory, the editors have selected preferences based on experience at Dow Chemical Co. The editors also point out that certain questions such as molecular weights of polystyrene, various kinetic mechanisms of polymerization, the structure of polystyrene, and relative values of different methods for the manufacture of certain derivatives are still in controversy. Of special interest is an appendix containing additional material on seven chapters to bring them up to date.

Chapter headings and their authors follow: "Introduction," A. J. Warner; "History," Boundy and Stoesser; "Manufacture of Styrene Monomer," J. E. Mitchell; "Physical Properties of Styrene Monomer," D. R. Stull; "The Chemistry of Styrene Monomer," G. H. Coleman; "Analysis of Styrene Monomer," E. N. Luce; "Handling Styrene Monomer," L. E. Lloyd; "The Polymerization of Styrene," L. C. Rubens and Boyer; "Summary of Uses for Styrene Monomer," J. W. Everson; "Molecular Weight and Solubility of Polystyrene," Boyer and R. Simha; "The General Physical Properties of Polystyrene," J. L. Williams and K. J. Cleerman; "Optical and Electrical Properties of Polystyrene," L. A. Matheson and J. L. Saunderson; "Rheological Properties of Polystyrene," R. S. Spencer; "The Degradation of Polystyrene," H. H. G. Jellinek; "Chemical Alteration of Styrene Polymers," G. D. Jones; "Alpha-Methylstyrene," J. L. Amos, K. E. Coulter, F. Tennant; "Ethylvinylbenzene and Divinylbenzene Mixture and Its Copolymers," Amos, Rubens, and H. G. Hornbacher; "Halostyrenes and Other Vinyl Aromatic Compounds," Amos and Everson; "Styrene Resins," G. A. Griess; "A Survey of Styrene and Polystyrene in Germany," W. C. Goggin; "Copolymerization," Simha and L. A. Wall; "A Survey of Patent Literature on Styrene Copolymers," W. J. LeFevre; and "Fabrication of Polystyrene," Goggin. The value of this book will be self-evident to all chemists and engineers concerned with the manufacture or handling of styrene for use in plastics, resins, and rubber.

"**Handbook of Chemistry.**" Eighth Edition. Compiled and edited by Norbert A. Lange, assisted by Gordon M. Forker. Handbook Publishers, Inc., Sandusky, O. Fabrikoid, 5½ by 8 inches, 2,014 pages. Price, \$7.

The value of this standard reference work is such as to require no further elaboration for any chemist or physicist. This new edition shows an increase of 78 pages over the seventh edition, but the continuing need of avoiding ungainly size and weight has resulted in the condensation or elimination of some of the tables appearing in previous editions. At the same time, new material has been added, and many tables have been expanded and brought up-to-date.

New material offered for the first time includes: ionization potentials of elements; classification of clay minerals; glossary of inorganic chemical nomenclature; titrimetric indicators; molar equivalents of a liter of gas at various temperatures and pressures; and density of moist air. Some 26 tables have been extended or completely rewritten, and the following three tables have been omitted: logarithms of atomic weights; heats of fusion of organic compounds; and synchronistic table of chemical journals.

NEW PUBLICATIONS

"**Roll Call.**" B. F. Goodrich Co., Akron, O. 20 pages. This booklet gives a list of all American motor vehicles in alphabetical order, together with the year each was introduced.

"Modern Textiles for Industry." Wellington Sears Co., 65 Worth St., New York 13, N. Y. 24 pages. This illustrated booklet describes the various natural and synthetic fibers, the conversion of fibers into yarns and fabrics, fabric weaves and constructions, and the applications of fabrics in rubber goods, coated products, laminated plastics, filtration, and other fields.

Publications of American Cyanamid Co., New York, N. Y. **"Casting with Laminac Resins."** 12 pages. The information in this booklet on the casting of Laminac polyester resins deals with resins and their properties, accelerators and catalysts, heat of reaction and cracking, fillers, molds, cure temperatures, and storage stability and catalyzed life.

"For the Best In Resin Adhesives." 26 pages. This publication consists of six individual folders describing the use of Ural (urea-formaldehyde) resins for hot or cold pressing with either cereal flour extenders or hardeners, and Melmac (melamine-formaldehyde) resins for hot press bonding.

"Philblack E in Natural and Synthetic Rubbers." Phillips Chemical Co., Bartlesville, Okla. 16 pages. This bulletin presents information on the properties of Philblack E, in comparison with Philblack O and EPC black, and also gives extensive laboratory test data comparing Philblacks E and O in natural rubber and GR-S cold rubber stocks.

"Pliolite S6B in Soles and Heels." Goodyear Tire & Rubber Co., Akron 16, O. 26 pages. This illustrated booklet gives information on the properties of Pliolite S-6B, its compounding in standard, cold, and oil extended GR-S, and typical formulations and test properties for shoe sole, innersole, leather-like goods, and other stocks containing the resin.

"This Is the Way to Paint Your Concrete Floors." 6 pages. Complete information on procedures for preparing and painting concrete floors with paints containing Pliolite S-5 appears in this illustrated folder.

"Description of Lustrex Styrene Nomenclature and Formulations." Technical Service Bulletin TPM-12 (revised). Monsanto Chemical Co., Springfield, Mass. 9 pages. This bulletin offers complete information on the company's new code system of nomenclature for Lustrex molding compounds and also lists the different available formulations together with their particle size and recommended applications.

"TIRES—TBA Merchandising." Bill Brothers Publishing Corp., 386 Fourth Ave., New York 16, N. Y. 16 pages. This bulletin on one of our associated publications describes the tire, battery, and auto accessories market and discusses the magazine's circulation coverage, editorial policy, and planned expansion program. The magazine was formerly known as *Tires Service Station*.

"Carbon Blacks, Bone Blacks, Iron Oxide Colors, Black Dispersions." Binney & Smith Co., 41 E. 42nd St., New York 17, N. Y. 4 pages. This technical brochure lists the properties of the company's rubber blacks, other carbon blacks, aqueous and base dispersions of carbon black, Mapico colors, and Ivo bone blacks.

"Mechanical Goods Division Products for the Process Industries." Form M-2165. United States Rubber Co., Rockefeller Center, New York 20, N. Y. 12 pages. This catalog describes and illustrates applications of the company's Royal-guard plastic protective coating; Permabond rubber linings for tanks, pipe, and fittings; Uscolite plastic fittings; special-purpose rubber hose; pinch valves; rubber expansion joints; conveyor belts; and packings.

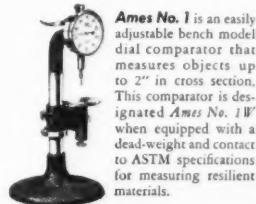
"U. S. Peerless Rubber Separators for Electric Storage Batteries." 13 pages. The features and superior performance characteristics of Peerless porous hard-rubber storage battery separators are described in this new catalog. Evaluation tests are also discussed.

"Carbowax Polyethylene Glycols." Carbide & Carbon Chemicals Co., New York, N. Y. 50 pages. Information is given on the firm's Carbowax compounds and their applications in rubber, textiles, adhesives, resins, and other products. Specifications and methods of analysis are also covered for the compounds, together with storage data.

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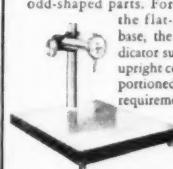
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"**Witco Stearates.**" Bulletin 53-1. Witco Chemical Co., 295 Madison Ave., New York 17, N. Y. 32 pages. Complete information is presented on the Witco line of aluminum, cadmium, calcium, lead, lithium, magnesium, sodium, and zinc stearates, as well as special soaps. Properties and applications are mentioned for each type, and the bulletin also covers government specifications for stearates, analytical methods, and a list of other Witco publications on stearates and special soaps.

"**Barrett Standard Industrial Chemicals.**" Barrett Division, Allied Chemical & Dye Corp., 40 Rector St., New York 6, N. Y. 16 pages. Condensed information is offered on the properties and applications of the company's chemical products, including rubber compounding materials, Cumar resins, phenolic resins, and plasticizers.

"**Aliphatic Nitrogen Compounds.**" Carbide & Carbon Chemicals Co., New York, N. Y. 44 pages. Information covers the properties, specifications, shipping data, and applications of 35 aliphatic nitrogen compounds available in commercial quantities. A bibliography of literature references is also included, together with brief descriptions of 18 amines available only in research quantities.

"**50-Year Index to ASTM Technical Papers and Reports.**" American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. Cloth, 6 by 9 inches, 215 pages. Price, \$6. This book provides a detailed author and subject index to all ASTM technical papers and reports appearing in the Society's publications during the period from 1898 through 1950. A separate condensed subject index lists all the technical symposia during the 50-year period. Also included are a list of special technical publications by the Society and a list of compilations of standards.

"**Flexoid Belt Matching Machine.**" Form FVM 124 C. Smith Power Transmission Co., Cleveland, O. 4 pages. Descriptions are given of the company's V-belt matching machine, available in three models for measuring belts up to 540 inches in length, with an accuracy of 0.10 inch, under tension equivalent to operating conditions.

"**Side Position Regulating Control.**" Bulletin 18-530. Westinghouse Electric Corp., Pittsburgh, Pa. 8 pages. This bulletin gives design information, specifications, and applications of the company's photoelectric scanning-type controls which maintain the traverse position of web materials with relation to processing machines during printing, slitting, trimming, winding, and other operations.

"**Spiratube-A and R.**" Catalog C2-4. Flexible Tubing Corp., Guilford, Conn. 8 pages. This catalog describes and illustrates two types of flexible tubing made from continuous helical coils of wire wound with overlapping plies of coated fabric. Applications include ventilation, fume and dust removal, and materials handling.

"**Paracril Nitrile Rubbers: Specification Compounds for MIL-R-3065 SB Series.**" Technical Bulletin No. 5. Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn. 34 pages. Many formulations and test data for base compounds are given to meet the requirements for the SB Series of specification MIL-R-3065. Paracrils B and BJ are used in these formulations, but it is noted that Paracrils 18-80, AJ, and C can be substituted for special purposes.

"**The Aniline Story.**" Allied Chemical & Dye Corp., New York, N. Y. 8 pages. An interesting history of aniline appears in this booklet, together with information on manufacturing methods, current uses in dyes and chemical intermediates, and future possibilities.

Publications of Underwriters' Laboratories, Inc., 207 E. Ohio St., Chicago 11, Ill. "Bi-Monthly Supplement to All Lists." August, 1952. 94 pages. "Accident, Automotive, and Burglary Protection Equipment Lists." September, 1952. 120 pages. "Bi-Monthly Supplement to All Lists." October, 1952. 79 pages. "America's Muscles." National Machine Tool Builders Assn., 10525 Carnegie Ave., Cleveland 6, O. 20 pages. "Automobile Facts and Figures." 32nd Edition-1952. Automobile Manufacturers Assn., New Center Bldg., Detroit 2, Mich. 80 pages.

"Physical Properties of Synthetic Organic Chemicals." 1953 Edition. Booklet F-1656. Carbide & Carbon Chemicals Co., New York, N. Y. 20 pages. This new edition presents data on more than 320 products classified into family groups and, for the first time, includes a section on 50 new research chemicals. Groups include plasticizers, esters, alcohols, glycols, ketones, ethers, aryls, aldehydes, and others.

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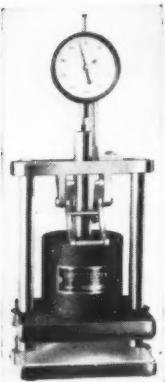
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Tire Industry in Brazil

(Continued from page 513)

Plans of various companies to increase capacity in 1951 could not be carried out according to schedule because of construction delays and difficulties in obtaining licences and foreign exchange to cover imports of machinery and equipment, and higher outputs from the new installations are not looked for until late this year.

By 1954, Brazilian capacity for producing tires should in any case show a marked upswing, for by then three new tire companies recently established here should be operating. Another new company that may be producing by 1954 is Dunlop do Brazil, which is to build a factory on a 60-acre site it has acquired on the Capivari River, S. Paulo.

Local tire manufacturers are employing rayon tire cord supplied entirely by the domestic rayon industry.

Vibrating Screen

(Continued from page 548)

they progress across the deck. These two motions give sharp and accurate sizing. The screens are made in both single- and double-deck models, all with three-inch discharge lips. The single-deck model is designed for easy conversion to two decks by the installation of skirtboards, screen cloth, buckup frame, and discharge lip.



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SEE PAGE 442

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ESTABLISHED MANUFACTURER'S REPRESENTATIVE: WISH to represent molded, die-cut, and extruded rubber producer capable of supplying automotive and allied industries. Contacting Detroit and Michigan area manufacturers. Technical background: B.S. degree (chemistry), excellent references. Reply Box 181, Birmingham, Mich.

CHEMIST-COMPOUNDER, 32, FAMILY, 10 YEARS' EXPERIENCE in manufacture and construction of tires and tubes, molded and extruded mechanicals, seeks responsible position in technical or sales line. Good personality and appearance. Address Box No. 1233, care of INDIA RUBBER WORLD.

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MARKET REVIEWS

RUBBER

MODERATE trading in both spot and futures rubber was noted during the period from November 16 to December 15. Prices rose throughout most of the period, reflecting increased domestic demand and the firmness of the foreign markets, but declined at the middle of December as the foreign markets eased off. As in previous months, factory demand for physical rubber was concentrated in the lower grades. By the end of November most manufacturers were said to have filled their requirements through January, and sales during the first half of December consisted mainly of fill-ins. Buying interest disappeared entirely during the last two days of the period as factories adopted a wait-and-see attitude as prices fell off.

NEW YORK SPOT MARKET WEEK-END CLOSING PRICES

	Sept.	Oct.	Nov.	Nov.	Dec.	Dec.
	27	25	22	29	6	13
R.S.S. #1	28.50	27.75	30.25	31.75	32.25	32.50
#2	27.75	26.00	28.75	30.75	31.25	31.25
#3	27.00	25.00	27.25	29.75	30.25	30.25
Latex Crepe:						
#1 Thick	38.50	36.50	38.50	39.75	40.00	40.75
Thin	38.50	36.50	38.50	39.75	40.00	40.75
#3 Amber						
Blankets	24.50	24.25	27.25	28.50	29.00	29.25
Thin Brown						
Crepe	23.00	23.00	26.00	24.25	28.00	28.25
Flat Bark	19.75	22.00	25.50	26.25	27.25	27.25

Highs for the period, established on December 9-11, and closing prices on December 15 for the various spot grades were as follows: #1 R.S.S., 33.25 and 31.25¢; #2 R.S.S. 32.00 and 30.00¢; #3 R.S.S., 31.00 and 29.00¢; #1 thick and thin latex crepe, 41.00 and 39.75¢; #3 Amber Blankets, 29.50 and 28.50¢; #3 Thin Brown Crepe, 28.50 and 27.50¢; and Flat Bark, 27.50 and 26.25¢.

COMMODITY EXCHANGE WEEK-END CLOSING PRICES

	Sept.	Oct.	Nov.	Nov.	Dec.	Dec.
Futures	27	25	22	29	6	13
Sept. 27	25.15	26.65	28.50	30.25	31.25	31.05
Mar.	24.85	26.20	27.70	29.15	30.30	30.05
July	24.60	25.80	27.20	28.70	29.70	29.20
Sept.	24.00	25.80	26.70	28.30	29.25	28.80
Dec.	—	—	26.70	28.30	29.25	28.80
Total weekly sales, tons	—	—	—	—	—	—
	1,460	2,310	2,530	4,180	3,850	3,150

Rubber futures prices followed the rising trend of the spot market, with short covering supplying the technical motivation for the price rise. Actual sales activity was only moderate; sales during the second half of November amounted to 6,710 tons, making the total for the month 12,720 tons. The sales volume for the first half of December totaled 7,590 tons.

Reflecting the spot market interest in the lower rubber grades, the Exchange adopted a #3 R.S.S. futures contract, effective on December 1, to supplement the existing #1 R.S.S. contract. March 1953, is the first delivery month against this new contract, which has #3 Fair Average Quality Ribbed Smoked Sheets (Exchange Type) as its basis grade. Also tenderable against the new contract are #1 Standard Quality Ribbed Smoked Sheets at a ½¢ per pound premium, and #2 Good Fair Average Quality Ribbed Smoked Sheets at a ¼¢ per pound premium. Activity in the new contract was light; sales for the first half of December were under 1,000 tons.

Latex

THE tight supply situation in both natural rubber and GR-S latices continued through the period from November 16 to December 15. Barring any unexpected change in supply or demand, this tight situation will apparently persist until about mid-1953. To justify this prediction, one market observer estimated fourth-quarter imports of Hevea latex as 4,600-6,200 long tons, dry weight, per month, as against an estimated monthly consumption of 6,000 long tons. Imports for the first quarter of 1953 are estimated at 5,600-5,900 long tons, dry weight, per month, as against a monthly consumption during this period of about 6,000-6,400 long tons.

Somewhat lower figures, which still show demand exceeding supply, are given by another market observer. He estimates first-quarter 1953 imports of natural latex at 5,400 long tons, dry weight, per month; while consumption will be about 5,600 long tons per month. World production of natural latex in 1953 is estimated at 110,000 long tons, dry weight, as against world consumption of 107,600 long tons. Of this consumption figure, the United States is expected to use 64,000 long tons of natural latex, as well as 51,000 long tons of GR-S latex. Total United States consumption of natural and GR-S latices in 1953 is estimated at 115,000 long tons, dry weight.

Production of GR-S latices is currently at full capacity, and it is reported that RFC is screening requests for latex to assure maximum utilization of existing supplies in view of the over-demand.

Final September and preliminary October domestic statistics on natural and synthetic rubber latices are shown in the following table:

(All Figures in Long Tons, Dry Weight)

	Pro-	Im-	Con-	Stocks
Natural latex:				
Sept.	0	3,828	5,313	7,824
Oct.	0	4,500	6,124	6,181
GR-S latices:				
Sept.	3,155	242	3,716	4,032
Oct.	3,511	272	4,031	3,771
Neoprene latex:				
Sept.	843	0	603	1,129
Oct.	679	0	742	1,070
Nitrile latices:				
Sept.	381	0	297	563
Oct.	440	0	270	584

* Preliminary.

Such small scattered lots of natural latex as are available are priced at about 42.5¢ a pound, dry solids, for spot delivery, and about 41.5¢ a pound for March delivery. April deliveries are reported to be priced at about 38.5¢ a pound. Prices for synthetic rubber latices remain unchanged, as follows: GR-S latex, 21.5-26.0¢ a pound; neoprene latex, 35-49¢ a pound; and nitrile latex, 32-60¢ a pound.

SCRAP RUBBER

ACTIVITY in the scrap rubber market during the period from November 16 to December 15 slackened off from the level of the preceding month. During the first two weeks business was good with both mixed tires and tubes in demand by re-

claimers. Most demand in tires was for truck and bus types, but sales were moderate in view of reclaimers' requirements of 30% minimum truck and bus types in mixed tire shipments, and scrap dealers fear of penalties because of excess moisture content in tires owing to outdoor winter storage.

Scrap tube activity also dropped off during the last week of the period, and some price declines took place, although tire prices generally held firm. The major factor behind the slackening in scrap rubber business was said to be the usual year-end inventory period of the mills and reclaimers. Scrap dealers are hopeful that business will go back to higher levels after the first of the year.

Following are dealers' selling prices for scrap rubber, in carload lots, delivered to mills at the points indicated:

	Eastern Points	Akron, O.
(Per Net Ton)		
Mixed auto tires.....	\$9.00	\$12.50
S. A. G. auto tires.....	Nom.	Nom.
Truck tires.....	Nom.	12.00 / 13.00
Peelings, No. 1.....	40.00	40.00
2.....	Nom.	25.00
3.....	20.00	20.00
(per Lb.)		
Auto tubes, mixed.....	2.75 / 3.00	3.00 / 3.25
Black.....	2.75 / 3.00	3.25
Red.....	8.50	9.00 / 9.50
Butyl.....	2.25 / 2.50	2.25 / 2.50

RECLAIMED RUBBER

PRODUCTION and consumption of reclaimed rubber were at high levels during the period from November 16 to December 15, although some slackening off was noted at the end of that time. Higher prices for natural rubber and the inability of some manufacturers to obtain sufficient synthetic rubber resulted in an active demand for tube stocks and the miscellaneous grade of pure gum reclaims. The decline noted at the middle of December was the usual year-end lull caused by inventory adjustments by consumers. All indications are that the new year will see the resumption of active trading in reclaims.

Final September and preliminary October statistics on the domestic reclaimed rubber industry are now available. September figures follow: production, 21,732 long tons; imports, 277 long tons; consumption, 23,131 long tons; exports, 860 long tons; and month-end stocks, 31,430 long tons. Preliminary October figures, in long tons, are: production, 27,451; imports, 169; consumption, 26,396; exports, 837; and month-end stocks, 31,378.

There were no changes in reclaim prices during the period.

Reclaimed Rubber Prices

	Lb.
Whole tire; first line.....	\$0.10
Fourth line.....	.0875
Inner tube; black.....	.15
Red.....	.22
Butyl.....	.125
Pure gum, light colored.....	.23
Mechanical, light colored.....	.135

The above list includes those items or classes only that determine the price basis of all derivative reclaim grades. Every manufacturer produces a variety of special reclaims in each general group separately featuring characteristic properties of quality, workability, and gravity at special prices.

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PLANT ENGINEER WANTED FOR MEDIUM-SIZE TIRE AND rubber goods plant—will be responsible for new construction, new equipment design, equipment maintenance, power plant operation, etc. Must be man who has had several years' experience in administrative capacity in plant engineering division in an industrial operation, preferably in rubber industry. Must have engineering degree or equivalent experience and training. Address Box No. 1234, care of INDIA RUBBER WORLD.

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FOR SALE: FARREL 16" X 48" AND 15" X 36", 2-ROLL RUBBER mills, also new lab. 6" x 12" & 6" x 16" Mixing Mills and Calenders, & other sizes up to 84". Extruders 1" to 3", Baker-Perkins Mixers 100, 50, 2, and 4½ gals., heavy-duty double-arm, Ball & Jewell & Leominster Rotary Cutters, HPM 200-ton vert. Hydraulic Press, 4-opening upstroke, 32" x 50" platens. Large stock of Hydraulic Presses from 12" x 12" to 48" x 48" platens from 50 to 2,000 tons. Hydraulic Pumps and Accumulators, Crushers, Churns, Rubber Bale Cutters, etc. SEND FOR SPECIAL BULLETIN. WE BUY YOUR SURPLUS MACHINERY, STEIN EQUIPMENT CO., 107—8th St., Brooklyn 15, N. Y. STERLING 8-1944.

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WORLD

COTTON AND FABRICS

NEW YORK COTTON EXCHANGE WEEK-END CLOSING PRICES

	Sept.	Oct.	Nov.	Dec.	Dec.	
Futures	27	25	22	29	6	13
Mar.	38.81	36.36	35.67	35.43	34.70	34.14
May.	38.68	36.52	35.56	35.82	35.12	34.55
July	38.15	36.34	34.83	35.93	35.34	34.75
Oct.	35.93	34.98	34.80	34.66	34.32	34.30
Dec.	35.79	34.90	34.75	34.61	34.31	34.23
Mar.	35.60	34.93	34.73	34.60	34.25	34.19

COTON market prices showed a continued downturn during the period from November 16 to December 15. Good activity and relatively firm prices were noted during the second half of November, but a sharp drop in prices took place during the first half of December in view of renewed hedging and liquidations, slow mill demand for cotton, lack of export activity, and indications of a large new crop. The latest government crop estimate, issued on December 8, placed the new crop at 15,038,000 bales, an increase of 133,000 bales over the November estimate.

The spot price for 15/16-inch middling cotton started the period at 35.05¢ reached a high of 35.40¢ on November 25, fell to a low of 33.05¢ on December 10, and then recovered to end the period at 33.80¢. Futures prices were somewhat firmer and showed a smaller decline over the period. Nearby futures held at higher than spot cotton levels, creating an attractive hedging situation.

Fabrics

Active trading in practically all types of wide industrial goods, as well as ducks, was noted during the period from November 16 to December 15. To a great extent this active market in sateens, broken twills, and drills was caused by orders from the automotive industry whose inventories are at very low levels. A tightening supply in many constructions became evident as sales were made into March.

Active trading in ducks took place into February, although some spot goods were said still to be available. Hove and belting ducks and chafer fabrics sold in moderate volumes for delivery through January, and some single yarn chafer sales were made for March delivery.

Cotton Fabrics

Drills

59 inch 1.85-yd	yd.	\$0.40	/	80.425
2.25-yd		.355	/	.36

Osnaburgs

40 inch 2.11-yd	yd.	.245	/	.16
3.65-yd		.155	/	.16

Ducks

38 inch 1.78-yd S. F.	yd.	.32		
2.00-yd D. F.		.355		
51.5-inch, 1.35-yd. S. F.		.5175		
Hose and belting		.70		

Raincoat Fabrics

Print cloth, 38 1/2-in, 64x60	yd.	.1575	/	.16
Sheeting, 48-inch, 4.17-yd		.225		
52-inch 3.85-yd		.245		

Chafer Fabrics

14-oz. sq. yd. Pl.	lb.	.76		
11.65-oz. sq. yd. S.		.68		
10.80-oz. sq. yd. S.		.7175		
8.9-oz. sq. yd. S.		.7325		

Other Fabrics

Headlining, 68 inch 1.35-yd.	yd.	nom.		
2-ply		.65		
68-inch, 1.25-yd, 2-ply		.65		
Sateens, 33-inch 1.32-yd		.60		
58-inch 1.21-yd		.655		

Tire Cords

K. P. std., 12-4-2	lb.	.85		
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RAYON

NOVEMBER shipments of rayon by domestic producers totaled 101,100,000 pounds, or 200,000 pounds over the October figure. Of this November total, 33,200,000 pounds were of viscose high-tenacity yarn, a decrease of 1,100,000 pounds from the preceding month's shipments. Calculated production of viscose high-tenacity yarn during November was 33,000,000 pounds, or 85% of capacity, and month-end stocks were 4,400,000 pounds.

All of the viscose high-tenacity yarn produced is not sold for ultimate use in tires and related products. A survey of such yarn shipments by domestic producers during the first nine months of 1952 was made by Textile Economics Bureau, Inc., and showed the following approximate distribution by end-use: tires, 290,630,000 pounds; hose and belting, 9,085,000 pounds; woven goods and other uses, 2,175,000 pounds; and exports, 2,080,000 pounds. These data include not only first-quality yarn, but also the off-quality grades sold for end-uses where the strength and uniformity required for tire yarn are not important. The figures for hose and belting include related non-tire rubber products such as fuel cell fabric. It is to be presumed that the main export item is yarn for tire manufacture.

No changes were made in rayon tire yarn and fabric prices during the period from November 16 to December 15, and current prices follow:



Estimated Automotive Pneumatic Casings and Tube Shipments, Production, Inventory, October, September, 1952; First 10 Months, 1952-1951

Passenger Casings	Oct., 1952	% of Change from Preceding Month	First	First
			10 Months, 1952	10 Months, 1951
Shipments				
Original equipment	2,634,799		2,349,221	19,468,513
Replacement	3,583,593		4,225,136	40,644,906
Export	58,625		91,298	617,018
Total	6,277,017	- 5.83	6,665,655	60,730,437
Production	7,185,388	+15.95	6,197,048	61,850,691
Inventory end of month	8,243,888	+12.98	7,296,715	8,243,888
Truck and Bus Casings				
Shipments				
Original equipment	565,140		476,327	4,433,394
Replacement	948,253		856,630	7,444,230
Export	55,116		49,942	680,665
Total	1,568,509	+13.42	1,382,899	12,558,289
Production	1,478,042	+23.83	1,193,582	12,342,704
Inventory end of month	2,577,525	+ 3.22	2,663,319	2,577,525
Total Automotive Casings				
Shipments				
Original equipment	3,199,939		2,825,548	23,901,907
Replacement	4,531,846		5,081,766	48,089,136
Export	113,741		141,240	1,297,683
Total	7,845,526	- 2.52	8,048,554	73,288,726
Production	8,663,430	+17.22	7,390,630	75,193,395
Inventory end of month	10,821,413	+ 8.65	9,960,034	10,821,413
Passenger Including Motorcycle and Truck and Bus Tubes				
Shipments				
Original equipment	3,197,891		2,819,854	23,894,116
Replacement	2,602,052		3,066,479	29,132,366
Export	59,495		97,964	906,055
Total	5,859,438	- 2.09	5,984,297	53,932,537
Production	6,220,157	+15.25	5,396,954	54,278,775
Inventory end of month	10,386,136	+ 2.98	10,085,670	10,386,136

NOTE: Cumulative data on this report include adjustments made in prior months.

SOURCE: The Rubber Manufacturers Association, Inc., 444 Madison Ave., New York 22, N. Y.

Rayon Prices

Tire Yarns

1100	480		\$0.63
1100	490		.62
1150	490		.62
1650	720		.62
1650/	980		.61
1900	980		.61
2200	960		.61
2200	980		.60
4400/	2934		.63

Tire Fabrics

1100	490	2	1.72
1650	980	2	.73
2200	980	2	.685

Compounding Ingredients — Price Changes and Additions

Accelerator-Activators, Inorganic

Litharge, Eagle	lb.	.175	/	.175
National Lead	lb.	.1675	/	.1685
Red Lead, Eagle	lb.	.185		
National Lezd	lb.	.1775	/	.18

Carbon Blacks

(CF) Aromex 115	lb.	\$0.089	/	\$0.129
(HMF) Statex 930	lb.	.047	/	.087

Colors, Black

Covinylblaks	lb.	.62	/	1.143
Ivo bone blacks	lb.	.15	/	.2025

Fillers, Inert

Clays, Hi-White R	ton	13.50	/	13.50
Suprex	ton	14.00	/	32.00

Plasticizers and Softeners

Fortex	lb.	.125	/	.143
Zolex 20	ton	120.00	/	140.00

Synthetic Resins

Kenflex A. L.	lb.	.26	/	.27
B.	lb.	.18	/	.24
N.	lb.	.18	/	.19

U. S. Imports, Exports and Reexports of Crude and Manufactured Rubber

	August, 1952		August, 1952		August, 1952	
	Quantity	Value	Quantity	Value	Quantity	Value
Imports for Consumption of Crude and Manufactured Rubber						
UNMANUFACTURED, Lbs.						
Crude rubber.....	139,898,862	\$37,485,360				
Latex.....	10,492,057	3,513,310				
Balata.....	35,104	9,037				
Jelutong or Pontianak	317,074	195,364				
Gutta percha.....	62,038	31,011				
Crude chicle.....	40,115	30,606				
Synthetic rubber.....	3,610,397	955,132				
Reclaimed rubber.....	134,741	7,392				
Scrap rubber.....	1,401,108	45,932				
TOTALS.....	155,991,496	\$42,271,144				
MANUFACTURED						
Rubber tires						
Auto, etc..... no.	5,751	\$368,799				
Bicycle..... no.	3,740	3,922				
Inner tubes						
Auto, etc..... no.	105	1,466				
Footwear: boots..... prs.	8,296	25,315				
Shoes and over-shoes..... prs.	32,996	33,735				
Rubber-soled canvas shoes..... prs.	9,137	4,401				
Athletic balls						
Golf..... no.	8,664	2,008				
Tennis..... no.	42,648	2,010				
Other..... no.	932	300				
Toys.....						
35,035						
Hard rubber goods						
Combos..... no.	27,936	2,819				
Drug sundries.....		729				
Other.....		7,374				
Rubberized printing blankets..... lbs.	1,445	3,954				
Rubber and cotton packing..... lbs.	1,856	3,460				
Gaskets and valve packing.....		2,616				
Molded insulators.....		435				
Belting..... lbs.	808	1,399				
Hose and tubing.....		16,983				
Gloves..... prs.	42,120	11,734				
Nipples and pacifiers gr.	1,842	2,425				
Instruments.....		3,527				
Other rubber products.....		308				
Gutta percha manufac-tures..... lbs.	1,635	3,602				
Rubber bands..... lbs.	986	1,170				
Synthetic rubber products.....		882				
Other soft rubber goods.....		97,310				
TOTALS.....		\$631,727				
GRAND TOTALS, ALL RUBBER IMPORTS.....		\$42,902,871				
Reexports of Foreign Merchandise						
UNMANUFACTURED, Lbs.						
Crude rubber.....	836,120	\$278,927				
GR-S type synthetic rubber.....	12,141	6,250				
TOTALS.....	848,261	\$285,177				
MANUFACTURED						
Rubber drug sundries.....		\$823				
Toys, balls, novelties		559				
Tires: auto and motor-cycle..... no.	27	794				
TOTALS.....		\$2,176				
GRAND TOTALS, ALL RUBBER REEXPORTS.....		\$287,353				
Exports of Domestic Merchandise						
UNMANUFACTURED, Lbs.						
Chicle and chewing gum bases.....		243,786				
Synthetic rubbers						
GR-S type.....	934,485	246,971				
Butyl.....		11,200	2,526			
Neoprene.....		2,480,237	1,015,604			
Nitrile types.....		788,072	414,643			
Other.....		90,023	55,130			
Reclaimed rubber.....		1,820,130	163,152			
Scrap rubber.....		2,475,986	68,367			
TOTALS.....		8,843,925	\$2,077,023			
Compounded rubber for further manufacture lbs.						
Other rubber manufac-tures.....		1,079,760	\$324,531			
TOTALS.....			\$11,479,909			
GRAND TOTALS, ALL RUBBER EXPORTS.....			\$13,556,82			
SOURCE: Bureau of the Census, United States Department of Commerce, Washington, D. C.						

United States Rubber Industry Employment, Wages, Hours

	Prod. Workers 1000's	Ave. Earnings Hours	Ave. Earnings Hours	Ave. Earnings Hours	Con- sumers Price Index
All Rubber Products					
Hard rubber goods					
Battery boxes..... no.	14,929	24,480	1939	121	\$27.84
Other electrical..... lbs.	87,281	61,247	1949	186	57.79
Other.....		27,431	1950	203	40.9
Rubber tires and casings					
Truck and bus... no.	60,567	3,611,689	1951	219	68.70
Auto and motor- cycle..... no.	98,304	1,140,385	1952	219	69.46
Aircraft..... no.	1,615	96,292		219	73.91
Off-the-road..... no.	12,722	1,590,341		219	74.91
Farm tractor..... no.	4,820	179,348	Jan.	218	40.9
Farm implement..... no.	6,321	152,973	Feb.	215	73.31
Other.....	8,292	38,226	Mar.	215	40.3
Inner tubes					
Auto..... no.	46,623	77,767	Apr.	213	39.6
Truck and bus..... no.	32,537	147,752	May	213	73.47
Aircraft..... no.	805	8,183	June	215	40.9
Other.....	18,097	78,678	July	201	73.42
Solid tires Truck and industrial..... no.	1,759	36,048	Aug.	211	74.93
Tire repair materials					
Camelback..... lbs.	423,272	134,656	1939	54.2	\$33.36
Other.....	420,788	431,474	1949	83.6	63.26
Tape, except medical and friction..... lbs.					
Other.....	71,162	61,982	1950	87.8	39.8
Belting: V-type auto..... lbs.					
Transmission: V-type..... lbs.	94,035	199,980	1951	87.8	39.6
Flat belts..... lbs.	33,862	54,763	1952	94.4	39.6
Conveyor and ele-vator..... lbs.	85,288	90,857	Jan.	94.4	38.6
Other.....	18,340	16,113	Feb.	94.2	38.7
Hose					
Molded and braided..... lbs.		361,335	Mar.	93.9	38.8
Wrapped and hand built..... lbs.	178,880	316,696	Apr.	94.6	39.3
Other hose and tubing..... lbs.	129,766	174,726	May	94.6	40.4
Packing					
Sheet type..... lbs.	50,374	39,501	June	95.3	40.5
Other.....	171,755	220,552	July	92.9	40.5
Tiling and flooring.....					
Mats and matting..... lbs.	314,824	115,844	Aug.	92.4	40.5
Thread: bare..... lbs.	344,605	102,525	Sept.	92.3	40.5
Textile covered..... lbs.	5,118	10,964	Oct.	92.5	40.5
Stocks					
Consumption					
Exports					
Month-End					

Rubber Footwear

Jan.	25.4	60.27	40.1	1,503
Feb.	24.7	60.46	39.8	1,519
Mar.	24.2	61.51	40.2	1,539
Apr.	22.0	59.42	39.3	1,512
May	23.5	60.69	39.9	1,521
June	23.7	61.38	41.3	1,523
July	18.6	58.34	39.1	1,492
Aug.	23.5	61.73	40.4	1,528

Other Rubber Products

Jan.	97.9	65.63	41.2	1,565
Feb.	96.3	64.43	40.6	1,587
Mar.	97.2	64.83	40.8	1,589
Apr.	96.3	63.68	39.9	1,596
May	95.0	65.32	40.8	1,601
June	95.7	65.73	40.9	1,607
July	89.0	62.96	40.0	1,574
Aug.	94.7	66.12	41.3	1,601

SOURCE: BLS, United States Department of Labor, Washington, D. C.

United States Rubber Statistics—September, 1952

	New Supply	Distribution	Month-End
Production	Imports	Total	Stocks
Natural rubber, total.....	0	\$48,957	33,961
Latex, total.....	0	3,828	5,313
Rubber and latex, total.....	0	52,785	39,279
Synthetic rubbers, total.....	451,655	2,108	279
GR-S types\$.....	2,669	54,957	78,366
Butyl.....	146,120	1,895	1939
Neoprene\$.....	15,535	213	1949
Nitrile types\$.....	55,262	0	1949
Natural rubber and latex, and synthetic rubbers, total.....	58,352	54,893	113,245
Reclaimed rubber, total.....	21,732	277	105,942
GRAND TOTALS.....	80,084	55,170	135,254
			279
			86,190
			141,837
			1950
			94.3
			59.76
			42.2
			1,528
			102.9
			63.26
			41.4
			1,528
			102.2
			63.06
			41.0
			1,538
			99.4
			62.68
			40.7
			1,540
			98.2
			62.36
			40.6
			1,536
			95.0
			65.32
			40.8
			1,601
			97.9
			65.45
			41.5
			1,577
			1952
			Jan.
			97.9
			65.63
			41.2
			1,565
			Feb.
			96.3
			64.43
			40.6
			1,587
			Mar.
			97.2
			64.83
			40.8
			1,589
			Apr.
			96.3
			63.68
			39.9
			1,596
			May
			95.0
			65.32
			40.8
			1,601
			97.9
			65.73
			40.9
			1,607
			Aug.
			94.7
			66.12
			41.3

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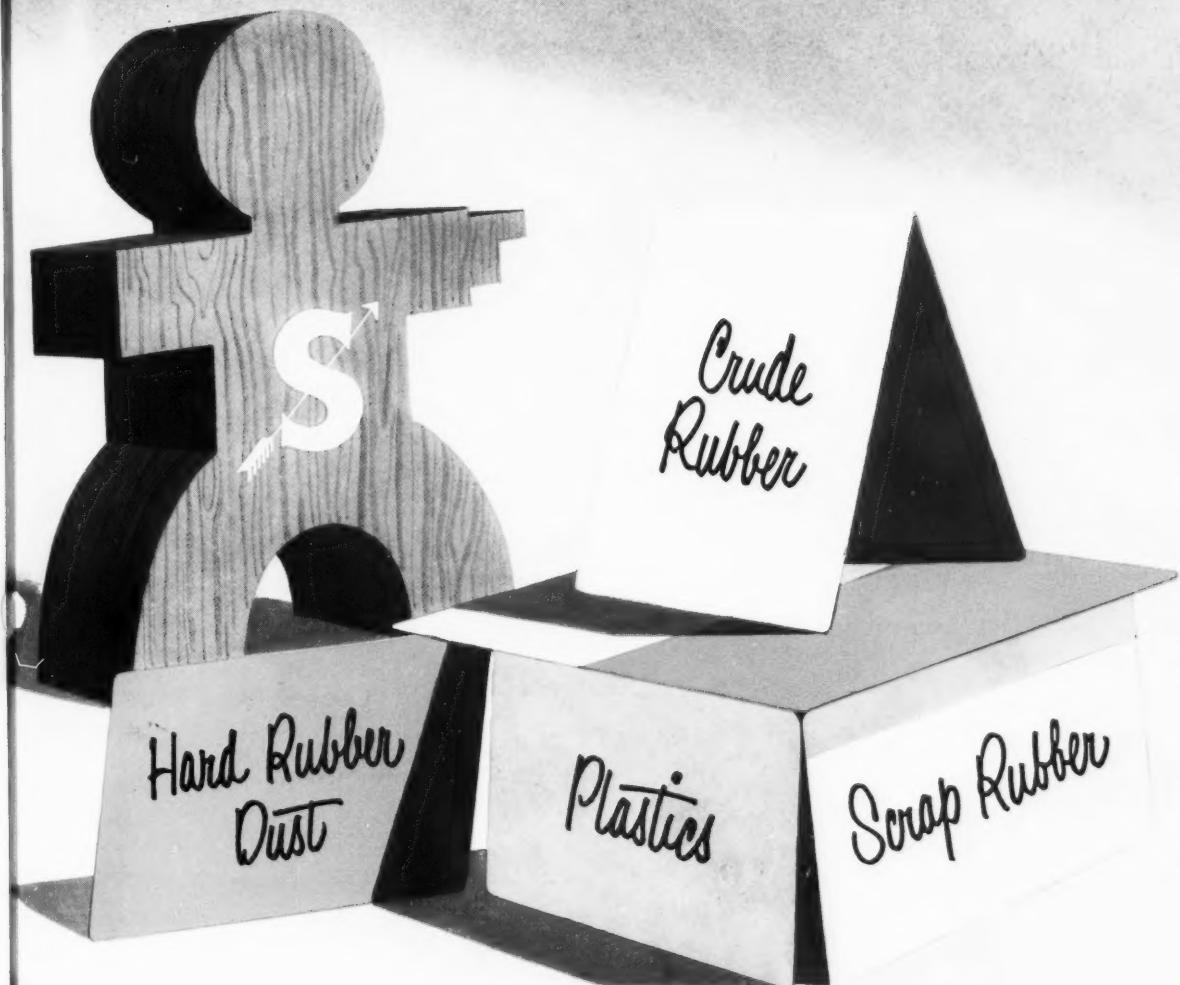
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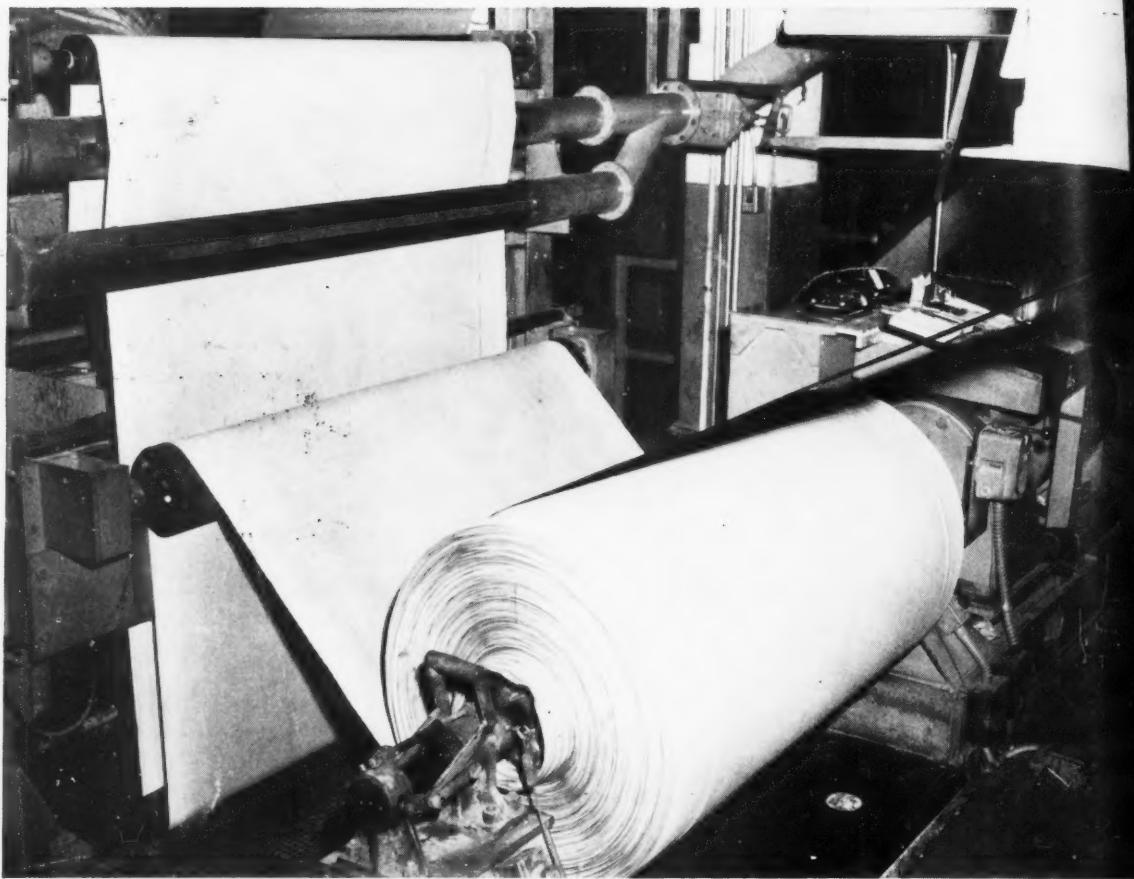
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